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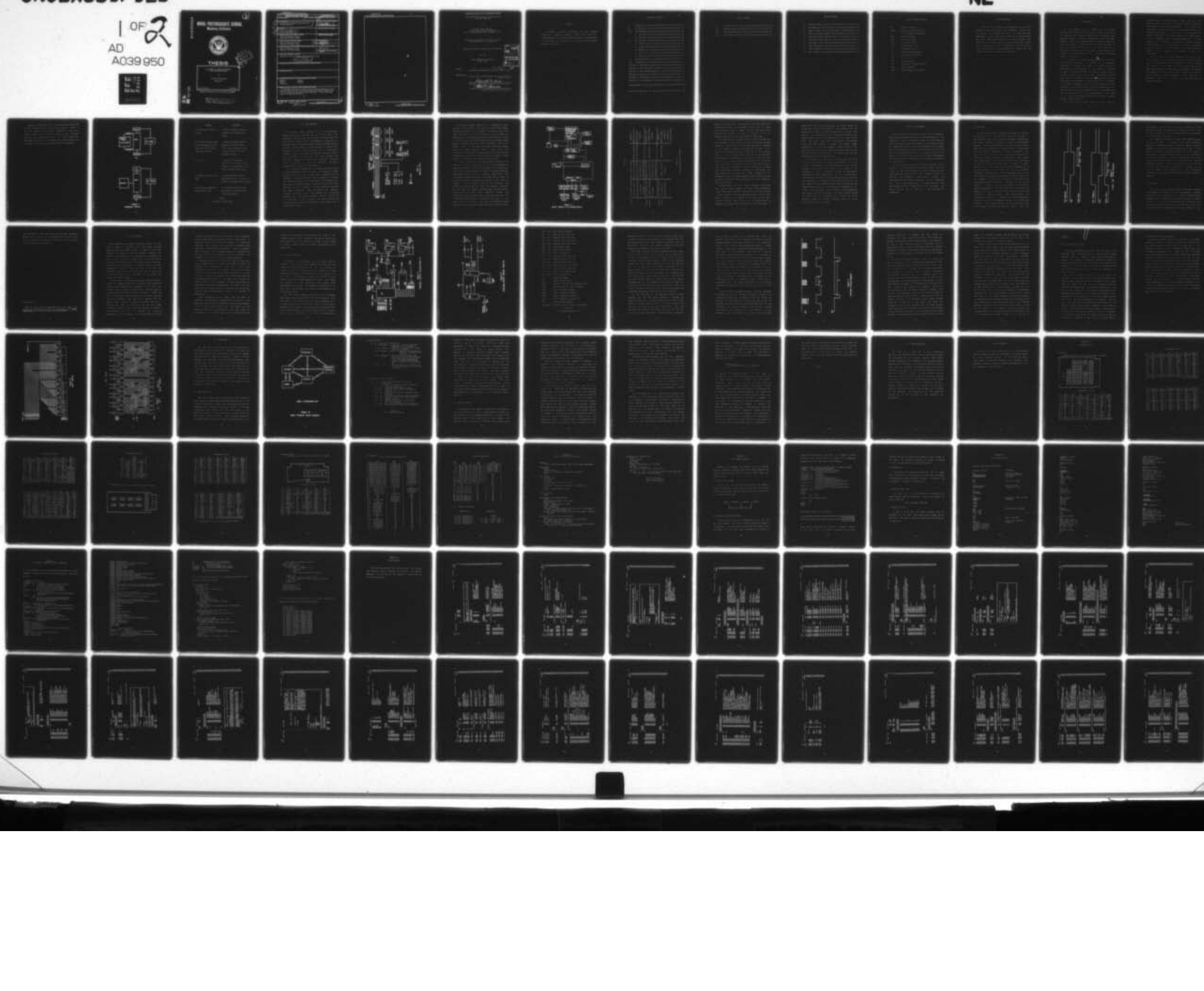

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NAVAL POSTGRADUATE SCHOOL

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THESIS

AN INTERACTIVE COMPUTER INTERFACE
WITH A DIGITAL RECEIVER

by

William Glenn Borries

March 1977

Thesis Advisor: S. Jauregui

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An Interactive Computer Interface with a Digital Receiver

by

William Glenn Borries
Lieutenant, United States Navy
B.S., United States Naval Academy, 1970

Submitted in partial fulfillment of the requirements for the degree of

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LIST OF ABBREVIATIONS

A/D	Analog to Digital
ASCII	American Standard Code for Information Interchange
Baud	Bits per second
D/A	Digital to Analog
high	TTL logic 1 (+5v)
I/O	Input and/or Output
IC	Integrated Circuit
IF	Intermediate Frequency
ISB	Intermediate Sideband
low	TTL logic 0 (0v)
LSB	Lower Sideband
TTL	Transistor Transistor Logic
USB	Upper Sideband
BFO	Beat Frequency Oscillator

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I. INTRODUCTION

For many decades man has dreamed of the day when machines could relieve him of much of his work. In this era of computers and advanced technology, this dream is now becoming a reality. Connecting computers to other machines, however, is not just a simple matter of running a wire from one to the other. In order for the computer to be able to use its "thinking" ability, it must have some way to translate its signals into a form that is recognized by the machine it is controlling. This is where the interface becomes all important.

An interface is a piece of equipment placed in the data path between two devices. Its purpose is to rearrange, translate, or change the speed of this data to meet the needs of one or both devices. In other cases the interface is used to convert data from an analog to digital (A/D) or digital to analog (D/A) form, or both. Interfaces of either type range in complexity from a few integrated circuits to the use of microprocessors. Most, however, fall in between. This thesis discusses the design and construction of an interface in this middle class. Here, the computers are the Applied Technology Airborne Computer (ATAC) minicomputer and the MOS Technology Inc.'s KIM-1 microprocessor. Their goal is to program and process outputs from a digitally tunable Watkins Johnson WJ-8888.

The two computer systems arrive at their goal by

different means. The ATAC uses a closed loop with the operator (Figure 1a) while the KIM-1 excludes the operator while executing its program (Figure 1b). In the ATAC loop the operator actively controls all communication between the computer and receiver. In this way it is possible to display information from the receiver on the video display at any time except during a scan (see Chapter V). It also provides quick reference to the data to be sent, the data last sent, and latest received data. This was invaluable during debugging. From the terminal it is also possible to adjust available parameters as necessary to meet any requirement.

The KIM-1 does not directly exchange digital words with the receiver, but rather exchanges digital data for analog data. This does not provide a feedback loop that includes the operator. Once begun, the KIM-1 program selects and sends data words to the receiver and processes the analog data received until the program comes to an end or is halted by the operator. Direct information is not available to determine when or if a digital word has been sent or received correctly.

Problems encountered during the design and construction of the interface and their solutions are shown in Table I. In this instance signal level compatability was not a problem because the I/O from the receiver, the interface, and the two computers were all TTL logic levels and, therefore, matched. It is believed that these problems are a typical list that may be encountered when interfacing.

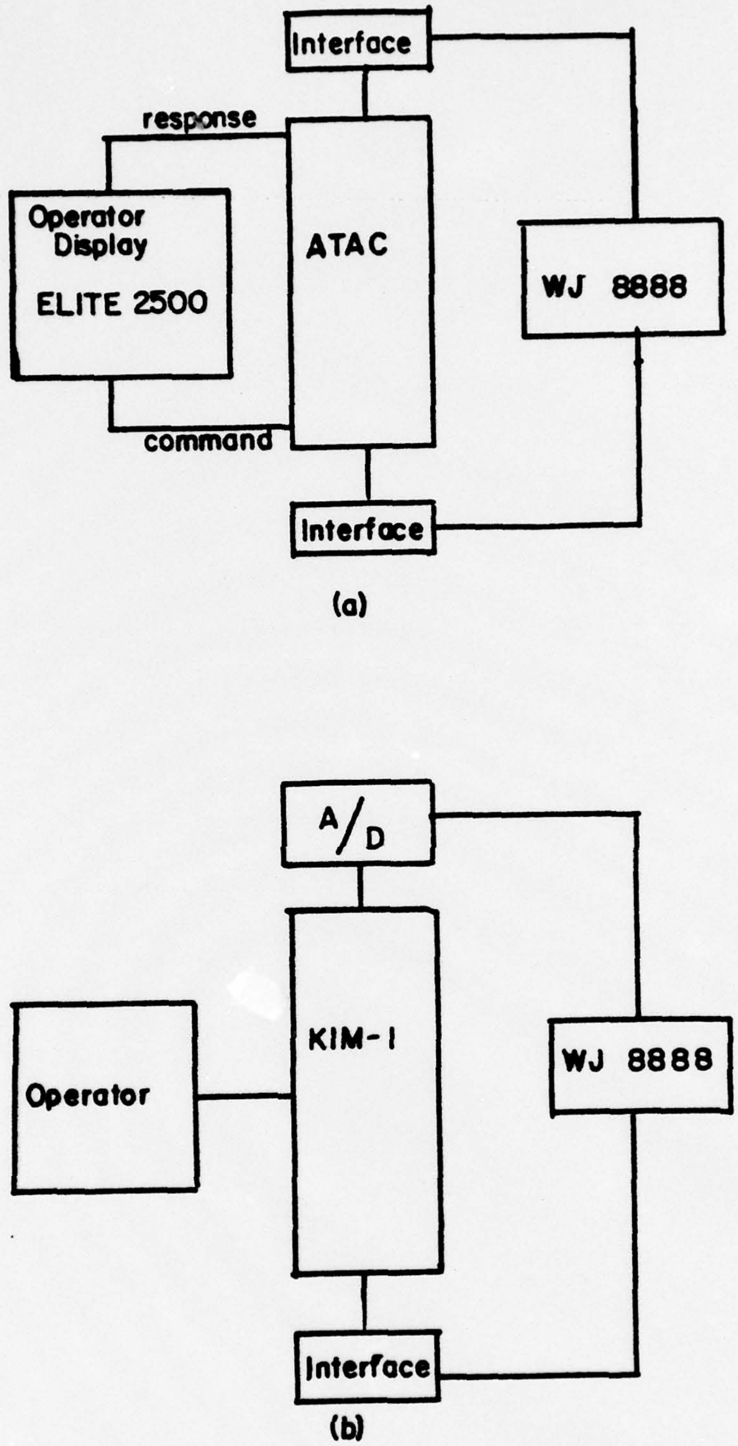


Figure 1
Computer Control

PROBLEM	SOLUTION
1. Noise on the ATAC I/O lines.	1. Use of Schottky circuits reduced or eliminated the noise.
2. Different clock rates of the computers and the receiver, and different data word lengths.	2. ATAC; converted parallel outputs into serial form. KIM-1; used interrupt lines to slave the KIM-1 to the receiver's clock.
3. Timing	3. Identified receiver periods by the Monitor Clock output. This provided a pulse which signaled stable data.
4. Inputting data to the ATAC.	4. Open collector buffers were used to sink the required current for proper data transfer.
5. Switching between the ATAC and the KIM-1.	5. Multiplexers and buffers were used to switch between the two computers.

Table I

Problems and Solutions

II. THE RECEIVER

The Watkins Johnson WJ-8888 (WJ) is an HF receiver designed for use in the 550 KHz to 30 MHz band. Its advantages include the ability to detect and output both the AM and FM IF signals while simultaneously maintaining a separate output of eight selectable detection modes. Options available to the operator include different IF bandwidths, variable RF gain, squelch control, and a tuneable BFO frequency. The WJ is digitally controlled and uses a 64-bit word as shown in Figure 2. This word contains the information necessary to transfer the frequency, detection mode, IF bandwith, RF gain, BFO frequency, and signal strength both internally and externally.

All inputs and outputs from the receiver are controlled by the synchronous, remote I/O board. This board is a gated transfer point for all digital data exchanged with the receiver. A number of control lines are needed to provide the necessary demands on the receiver. Three balanced input pairs and four balanced output line pairs, plus a ground are provided for this purpose. All three inputs are required for remote operation. They are address (or enable), trigger, and data input. The address pair is the most important for it serves as the master "on-off" switch for the remainder of the I/O pairs. The outputs furnish the required clocks (command and monitor), output data, and a local/remote status.

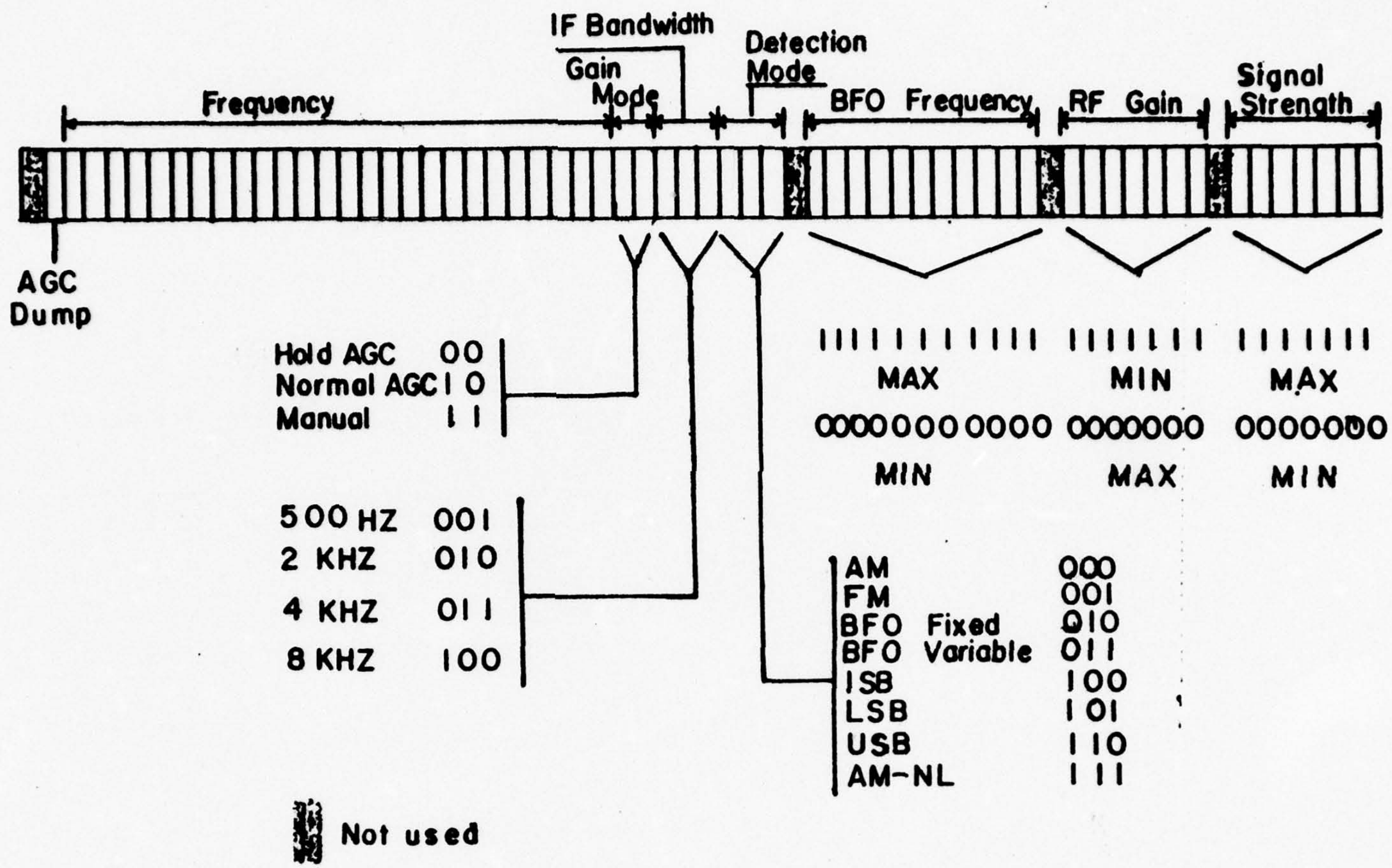


Figure 2
Receiver's Word

The Watkins Johnson operates on a sequential cycle divided into four equal periods and six identifiable modes. The periods regulate the different operations while the modes ascertain the origin of the data. Table II shows the interaction of the periods and modes of the receiver. Three of the six modes are memory read and write functions; these cannot be remotely controlled and, therefore, are of no concern here. Of the remaining three, two are the remote active and remote passive modes. These allow the introduction of externally generated data and prevent manual intervention during all but one of the four periods. Manual control is available in the remaining mode, local.

In order to manage the data word movement correctly, the receiver utilizes a common bus or data node arrangement as shown in Figure 3. This simplifies operation by forcing all data words to pass through this node in the same direction, regardless of their origin or desired destination. The multiplexer controls the input to the data node. Control of the multiplexer and, therefore, the origin of the data is managed by the internal modes of the receiver. The objective of period one is to load the receiver register. In the local and remote passive modes, the data word is shifted from the front panel register, through the multiplexer and data node, into the receiver register. The difference between these two modes is in the action of the data prior to shifting. The local mode updates the data word from the front panel storage registers during the early

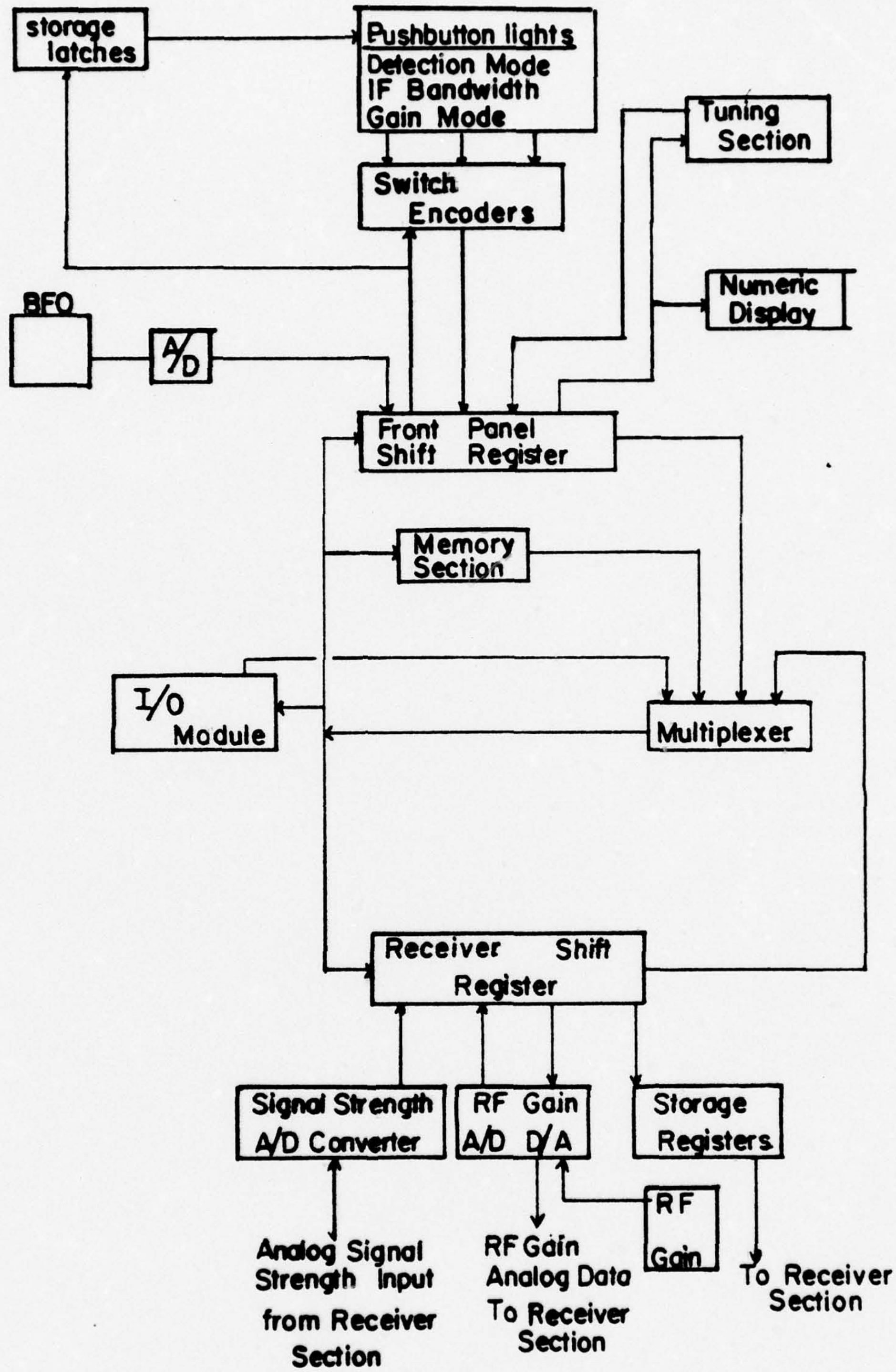


Figure 3
Block Diagram of the Digital Section

Period

	1	2	3	4
Local	Load Front Panel Reg from Front Panel/word shifted to Receiver Register	Load Rcvr Storage Reg/ Signl Strength and RF gain updated /word shifted to FrontPanel Register	Display updated no words shifted	Change to Remote Active or Remote Passive possible
Remote Passive	Word shifted from FrontPanel Register to Receiver	Update only Sig Str /Load Rcvr Storage Reg/word shifted to FrontPanel Reg.	Same as Local	Change to Lcl or Remote Active possible
Remote Active	Word shifted from I/O module to Receiver Register	Same as Remote Passive	Same as Local	Change to Remote Passive automatic. Change to Local possible

Table II

Receiver Modes and Periods

portion of period one. This action is inhibited during the remote passive mode. In the remote active mode the data word originates from a remote device, is shifted by the command clock through the remote I/O board, on to the receiver register via the multiplexer and data node.

The first part of the second period is spent loading the data shifted during period one into the receiver storage registers. During this time the signal strength is updated in the receiver register regardless of the mode. The RF gain A/D-D/A converter functions according to the selected mode. In the local mode the RF gain bits in the data word are replaced by A/D conversion of the front panel RF gain control knob. The two remote modes reverse this action and load the RF gain D/A converter with this data from the word. After this is completed, the word is shifted in all modes out of the receiver register, through the multiplexer and data node, and into the front panel register. If the address line from the remote device is active high, the data word and the monitor clock are available on their respective output line pairs.

Periods three and four inhibit movement of the data word. Period three updates the front panel pushbutton lights and numeric display. Period four is the only period in which changes in receiver mode are allowed. During this period changes from a remote mode to local, or from local directly to remote passive can only be accomplished by depressing the appropriate pushbutton on the front panel. A

change from local and remote passive to remote active is automatically done by the remote I/O board whenever both the address and trigger line pairs are active high during this period. The remote active mode immediately reverts to the remote passive mode at the beginning of the next period four. The total cycle time of the receiver is 10.24 msec (2.56 msec per period). In order to change modes successfully, it may be necessary either to hold in the pushbutton or to hold the trigger and address lines high for up to 7.68 msec (three periods). This ensures that the mode change demand occurs in period four.

All outputs are available from connectors J1, and J6 through J10 located on the back of the receiver. J1 is the digital I/O connector. The other connectors are all analog outputs. J6 is a 455 KHz IF signal of at least 20 KHz bandwidth. AM and FM detector monitors are provided at connectors J7 and J9 respectively. J8 is a predetection, 455 KHz center frequency IF output whose bandwidth is set by the front panel. A balanced and unbalanced line audio and both upper and lower sideband outputs are available from the appropriate pins at J10. The balanced line operates at all times. The unbalanced line is operable unless headphones are plugged into the front panel. The lower sideband output is active when the receiver is in either ISB or LSB detection modes, and the upper sideband output is active during ISB, USB, and CW modes.

III. THE COMPUTERS

After studying the inputs and outputs from the receiver, three choices were available for further development of the interface. It could be designed to pass the clock pulses on to the interrupt lines of the computer and, therefore, match the computer's timing to that of the receiver. Or, a buffer could be constructed to input the data serially at the clock rate of the computer and output it at the clock rate of the receiver. The third choice, also a buffering arrangement, could exchange data in parallel to the computer and serially to the receiver.

The chief factor influencing the design decision was the availability and distribution of computer control and I/O lines. For the first computer, the primary objective was to investigate the feasibility of both remotely tuning the receiver and accepting a data word in return. The requirements for the second computer, the MOS Technology Inc. KIM-1, were less strict. Its objective was to tune the receiver digitally through use of the interface. Its input, however, was to come from a A/D converter for processing.

A. THE ATAC

The ATAC was originally designed to provide EW service to aircraft. Built to do real-time analysis of signals, it has very short cycle times, optional microcode programming, and double precision arithmetic as part of the standard package. All this, combined with its large instruction set, makes the ATAC a versatile and powerful tool. Although data could be transferred serially by proper programming, the ability of the ATAC to both input and output sixteen bits in parallel on the PIO (parallel input/output) lines proved more advantageous. Any one of the ATAC's sixteen registers can input or output from these lines. In order to properly transfer this data, the PIO bus must be augmented by an address provided by the sixteen bits of the "eXtended" Arithmetic Register (XAR). Another necessary output is one that informs the external device when the ATAC is ready for the transfer. On the ATAC this function is provided by the Input/Output Demand (IOD) line. Referring to the timing diagram in Figure 4, an input command is initiated by placing an address on the XAR lines and following this address with a low on the IOD. This signifys that the ATAC register is ready for data. After approximately one microsecond, the IOD is placed high and the address is removed. During this microsecond the data for the ATAC must be stable. For an output command, the XAR and the PIO lines first present the address and data for output. When they

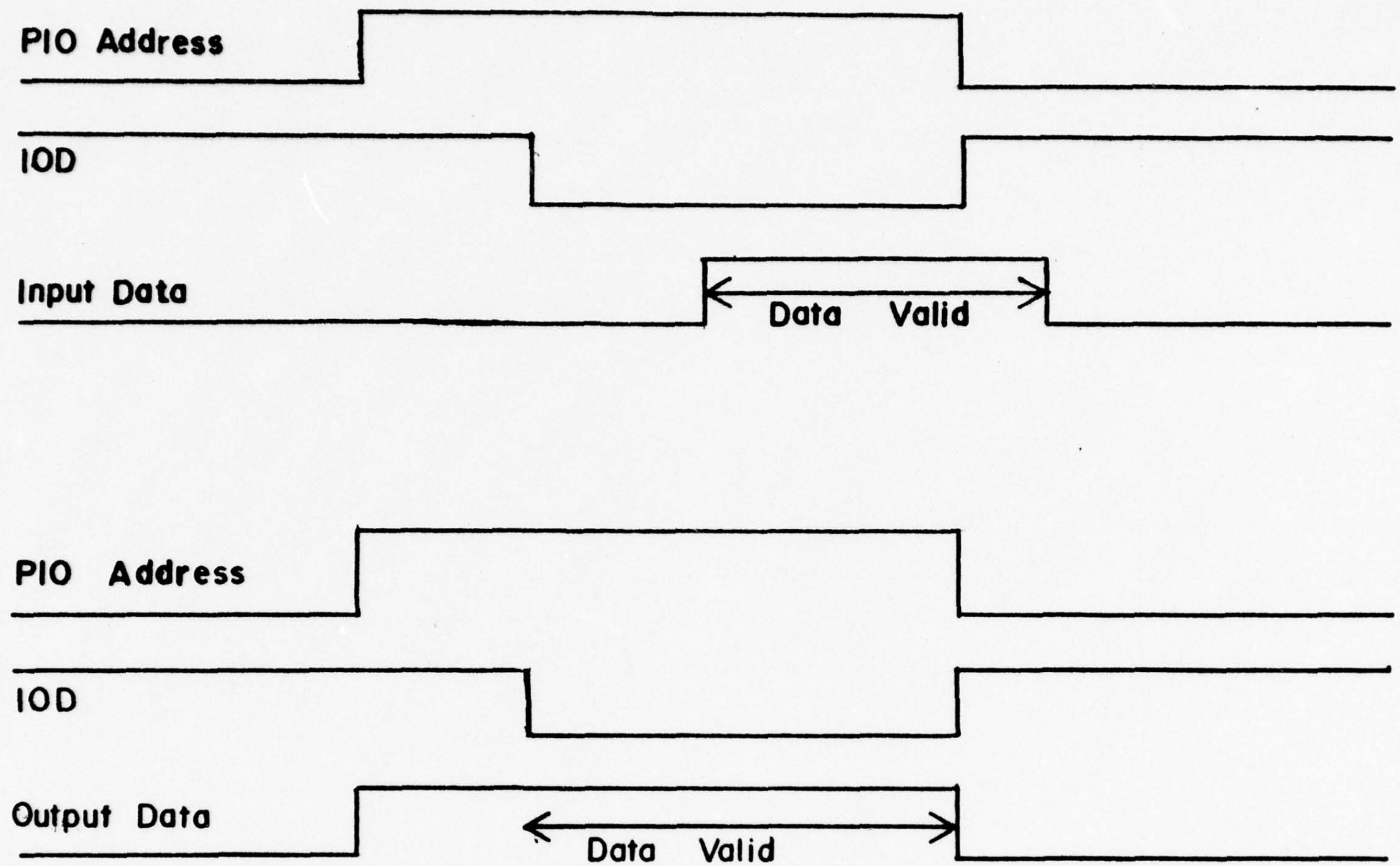


Figure 4
ATAC I/O Timing Diagram

are stable, the IOD line is set low. The data is then available for about a microsecond, as before. The IOD line is then placed high and the address and data are removed from their respective lines.

For operator interaction a serial ASCII, RS232 I/O port is also available. A Datamedia Elite 2500 television terminal is connected here to provide the operator with the necessary control and programming capablity for use of the ATAC. By proper programming and use of the XAR lines, it was possible to translate each command for the interface. Using a demultiplexer on the interface board, four of the five available XAR addresses were separated into sixteen separate commands. One of the remaining lines and the IOD line were used as strobes to identify the receiver and to signify stable data (Chapter III). This arrangement provided both the adequate isolation and flexible operation desired.

B. THE KIM-1

The KIM-1 is at the other end of the computer spectrum with respect to the ATAC. It is a microprocessor designed around the MOS Technology Inc. series MCS6500 Central Processor Unit. Complete on a single printed circuit board, the KIM-1 is simple to operate and easy to program. While its cycle time is slower than that of the ATAC, it is still much faster than the receiver and more than adequate to meet

the requirements. Since the input data came from converted analog data supplied from the receiver's FM IF output (J9) and an external A/D converter, the design for this portion of the interface was simpler.[1]

----

[1]For a more detailed discussion of the KIM-1, its objectives, programs, and operating procedures, see Signal Acquisition and Sampling Using a Microprocessor, by LT. D. Rosenberger.

IV. THE INTERFACE

The interface was initially designed solely for the ATAC. A means of converting four ATAC words into one receiver word was needed first, in order to test the program, the computer, and the receiver together. The simplest and cheapest way to accomplish this conversion and still fully utilize the capabilities of the ATAC was to build a 64-bit register using eight parallel-in, serial-out, eight-bit shift registers. A control section was also necessary to properly handle this data. The ATAC XAR addresses were decoded by this control section to provide the load commands for the registers and to signal the receiver to input the word.

The next step in construction was also simple in theory. Since the computer uses the PIO lines for input as well as output, what was needed was a connection which would not interfer with the section already built. The ICs chosen to isolate the two sections are called Tri-State. These ICs have a "no output" state in addition to the normal high and low of TTL circuits. They could not, however, sink or supply enough current to drive the computer PIO bus. A solution was found by following these ICs with open collector buffers. Not only did they provide the necessary amplification, they did not degrade the isolation performance of the Tri-States. This second section also had

a 64-bit register built from the smaller shift registers. In this case, though, they were serial-in, parallel-out. In order to remove the word from the register in sixteen-bit sections, the outputs from the shift registers were connected to four-to-one multiplexers. These multiplexers were Tri-State. With the proper control it was possible to shift the word from the receiver into this register, and transfer it to the PIO bus in the correct sequence.

Increased complexity in the control section came with this implementation. A method was needed to prevent the computer from transferring a word until it had been completely shifted into the register. The period two clock output from the receiver was used as a reference to provide a pulse to inform the computer when shifting was complete. This pulse was positioned in the same time interval as period three of the receiver. The additional benefit of identifying period four was obtained. This meant that the output for the trigger line to the receiver could be shorter and still meet the requirement to occur in a portion of period four.

After completion of the testing for the ATAC, an interface was designed and constructed for the KIM-1. This design was very simple to implement, since all the necessary timing circuits were already built and tested. The two computers were kept from interferring with each other by installation of a manual switch. This switch controls the

address of a multiplexer that separates the lines in the interface common to both computers. The control section was wire-wrapped rather than placed on a printed circuit board to provide greater flexibility, easier maintenance, and to reduce cost.

A. THE CONTROL SECTION

The heart of the interface is the control section (Figures 5 and 6). The main purpose of this section is to decode and route commands from the ATAC and provide the necessary circuits to interface with the receiver. It also contains the circuits for the operation of the receiver by the KIM-1. The receiver's outputs are driven by line drivers which provide complementary TTL levels. The inputs are applied to line receivers which accept these complementary TTL levels. The interface, therefore, had to use these same receivers and drivers to be compatable with the Watkins Johnson.

The SPST switch mounted on the front of the interface case selects the computer controlling the receiver. With the switch in the ATAC position, a high is placed on pin 1 of IC-JJ and pins 1 and 10 of IC-MM. IC-JJ is now set up to transfer the following: the address and data outputs to the line drivers on IC-LL, the trigger command to pin 2 of IC-Z, and a low in line CCK7. The CCK7 line completes the

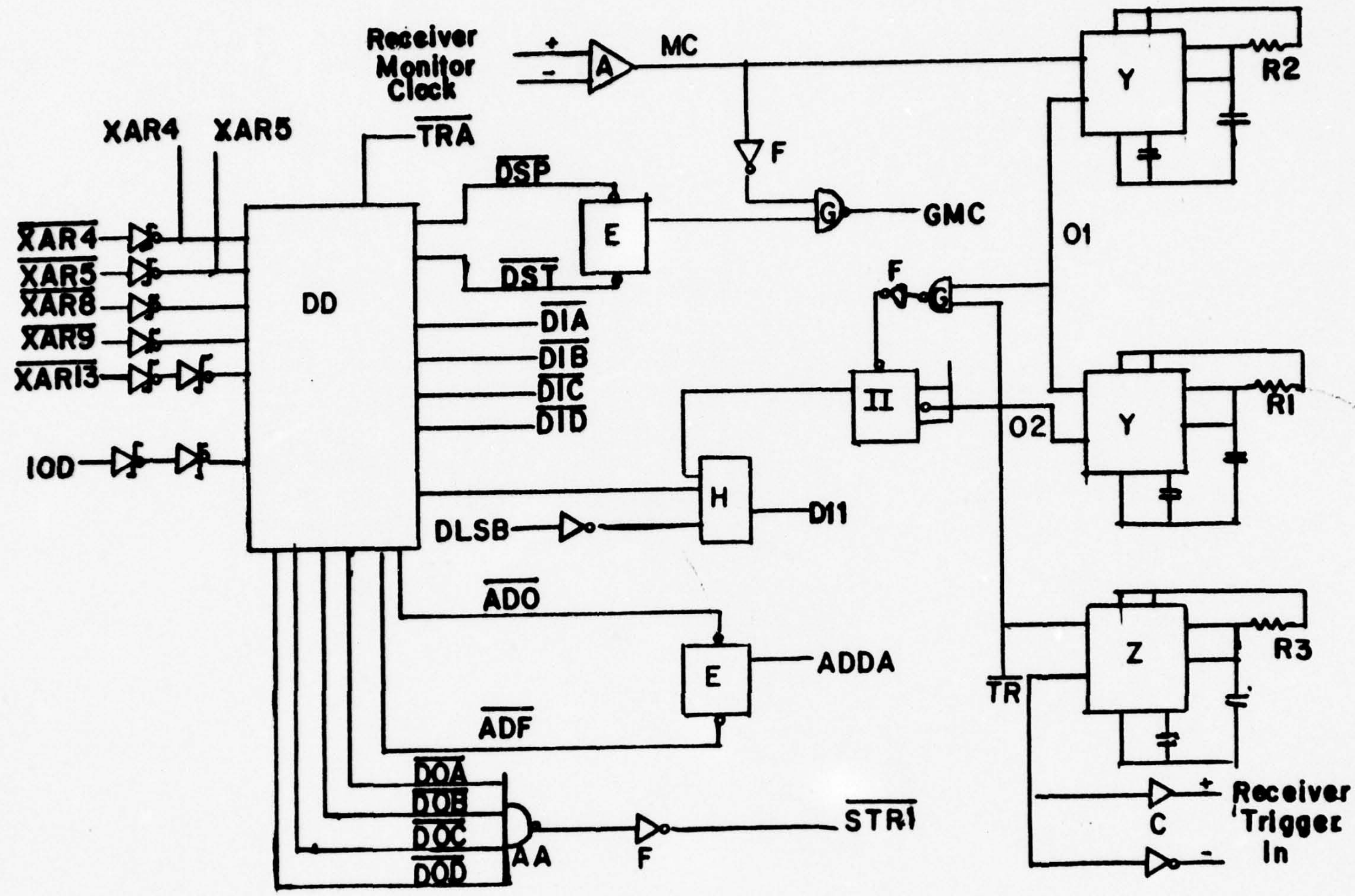


Figure 5
Interface Control Section (Part I)

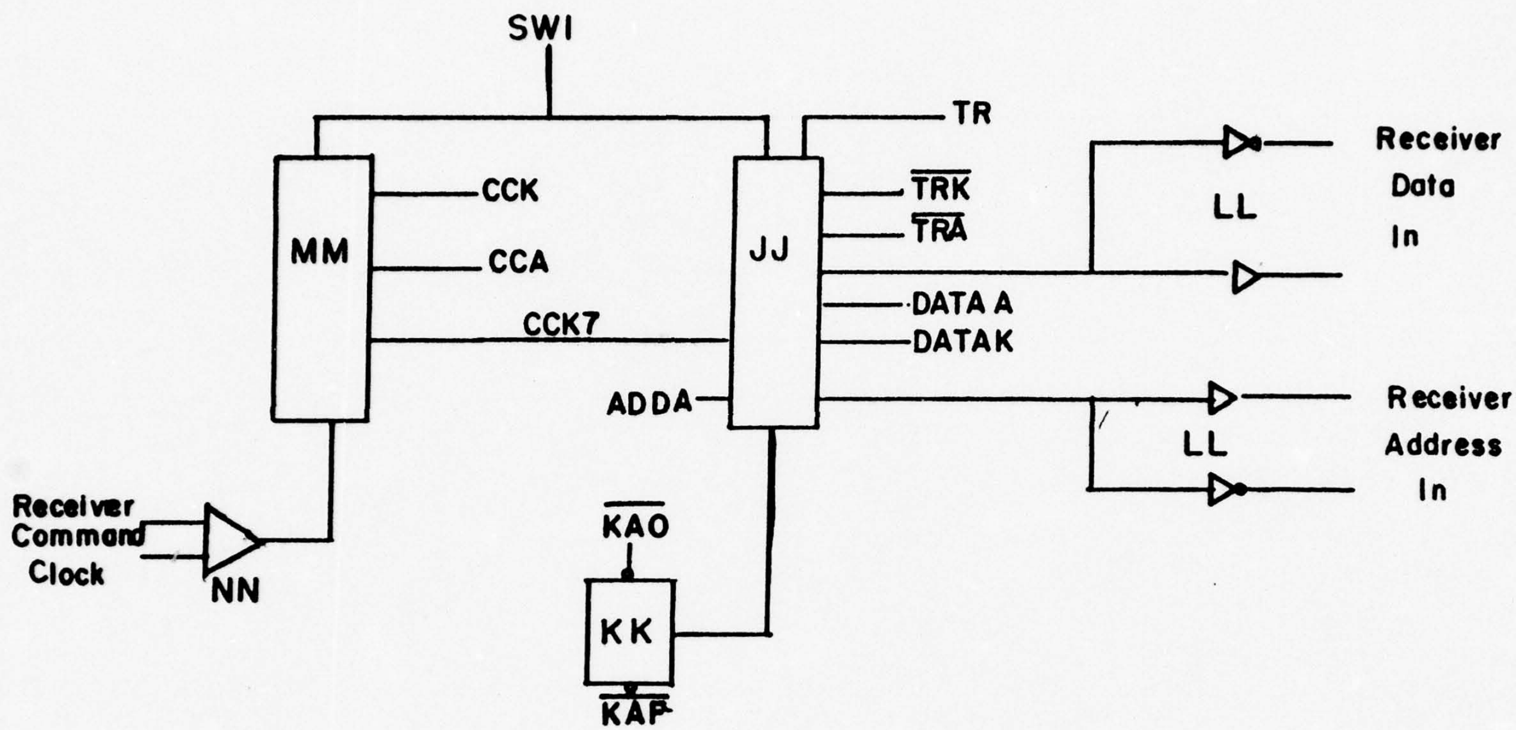


Figure 6
Interface Control Section (Part 2)

TRA	[0]	ATAC Trigger Commmand
DIA	[1]	Receiver input word one
DIB	[2]	Receiver input word two
DIC	[3]	Receiver input word three
DID	[4]	Receiver input word four
DSP	[5]	Stop Monitor Clock
DST	[6]	Start Monitor Clock
ADO	[7]	ATAC - Address on
DOA	[8]	Receiver output word one
DOB	[9]	Receiver output word two
DOB	[9]	Receiver output word two
DOC	[10]	Receiver output word three
DOD	[11]	Receiver output word four
RDY	[12]	Read D11 for ready signal
ADF	[15]	ATAC - Address off
TR		Receiver trigger
CCK		Kim-1 Command Clock
CCK7		Control Line for Kim-1 Command Clock
CCA		Command Clock for ATAC interface
ADDA		ATAC - Receiver Address
KADD		KIM-1 - Receiver Address
KAO		KIM-1 - Receiver Address On
KAF		KIM-1 - Receiver Address Off
TRK		KIM-1 Trigger Command

(Numbers in brackets refer to ATAC XAR commands)

Table III

Interface Command List

commands to IC-MM. This IC is a quad Tri-State buffer which is used to control the destination of the command clock. The switch opens buffer one which directs the command clock to the ATAC. The CCK7 line closes buffers two and four disabling the command clock input to the KIM-1.

The ATAC supplies the control section with six lines. Five of these are the XAR bits 4,5,8,9, and 13. Using 4, 5, 8, and 9 as address lines to pins 20-23 of IC-DD, a four-to-sixteen demultiplexer, sixteen (2^4) unique commands (Table III) were made available. The sixth line, the IOD, and XAR 13 were used as strobes or enables for the demultiplexer. In this way XAR 13 was able to specify this receiver uniquely, and the IOD ensured that addresses and data were stable before passing a command. When both IOD and XAR 13 are low, IC-DD is operational and the output corresponding to the address on pins 20-23 is forced low. At any time that either or both the two strobe lines are high, all outputs of IC-DD are held high and no commands are generated, regardless of the activity on pins 20-23.

At the beginning of the Receiver Control program (Chapter IV), the ATAC sends commands to address the receiver (ADD) and to open the gate for the monitor clock (DST). ADD places a low on pin 2 of IC-E, setting the flip-flop and forcing the ADDA line high. This line activates the receiver's I/O through ICs -JJ, -A, -B, -C, and -LL, as described above. The DST command is passed to

pin 7 of IC-E. This sets this flip-flop and allows the monitor clock (MC) to shift data from the receiver into the storage register during every period two of the receiver's cycle. The MC line is also connected directly to a timing circuit. This circuit produces the pulse described in the early part of this chapter. The first of a pair of monostable multivibrators, IC-Y (Figure 5) is triggered by the first clock pulse of MC. IC-Y outputs a pulse, interval A of timing diagram (Figure 7), which triggers the second. The second's output, interval B, is connected to pin 1 of IC-II, a negative-edge triggered, J-K flip-flop. This IC is wired so that it is set on the output of the second multivibrator and reset by either the the output of the first multivibrator or the command TR. The output of this flip-flop, pin 15, is called the RLP. This line is multiplexed with the least significant bit of the output register and inverted by IC-H for use by the ATAC on line D11.

The RLP pulse is adjustable through variable resistors (trimmers) one and two. Trimmer one controls interval B and trimmer two interval A. In effect, trimmer two varies the position of the pulse and trimmer one its width. The placement and width are the key to proper operation of the interface. The pulse must remain in period three. Although some overlap into period four is allowable it is not desirable, and any overlap into period two could cause

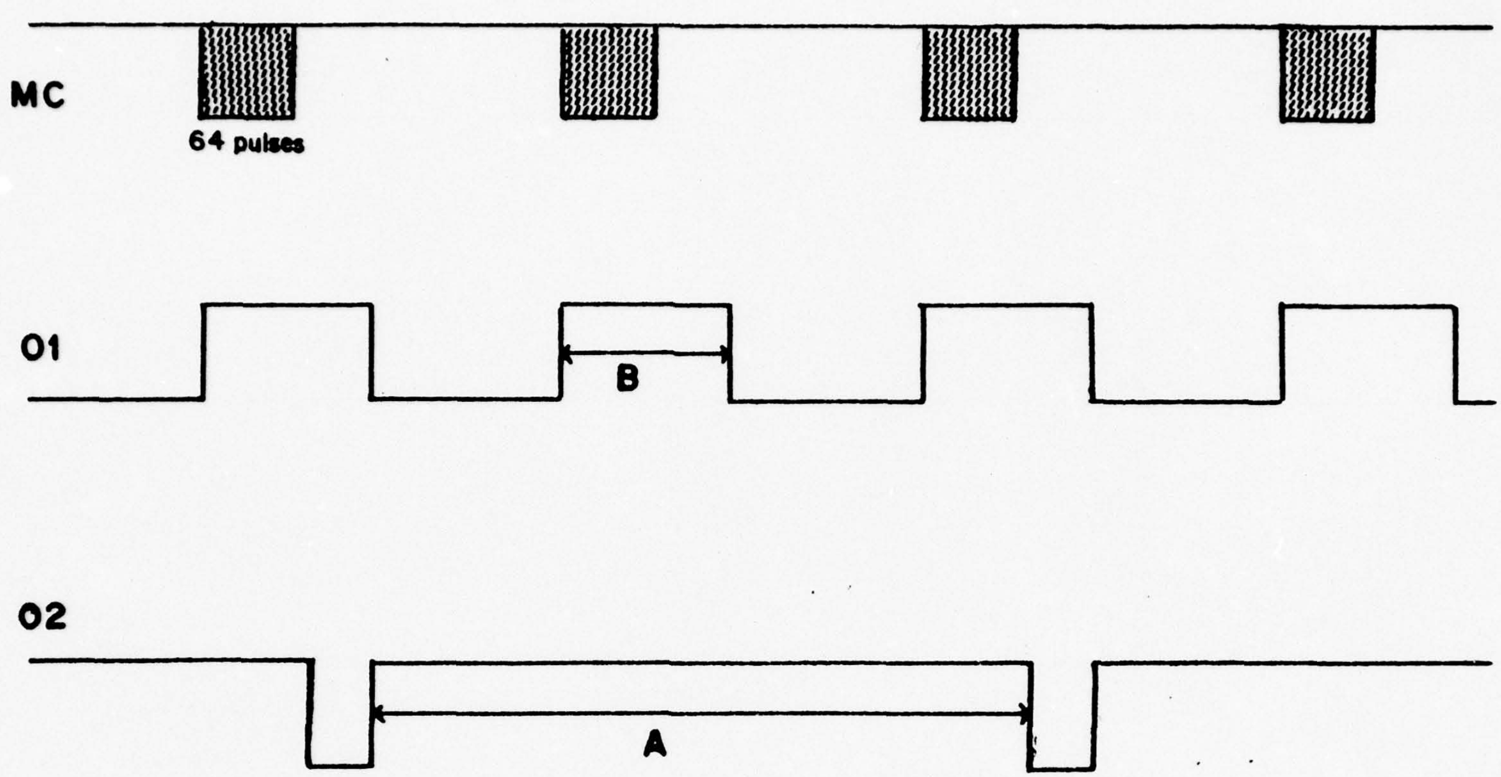


Figure 7
Interface Timing Diagram

incorrect operation. At present, the RLP pulse is programmed for every other period three. This allows the receiver to stabilize between samples taken by the computer. If more or less time is desired, the pulse can be set in every, every other, or every third period three by varying trimmer one. Greater time between pulses can be achieved by changing the .47 uF capacitor (HH-7,8) to one of larger value.

When the ATAC is ready to send a word, it loads the input register of the interface using commands DIA, DIB, DIC, DID, and then waits for a high on the DI1 line. When RLP is low, DI1 is high and the ATAC sends command TRA. This command is routed to a separate monostable multivibrator, IC-Z, by way of multiplexer IC-JJ. The timing circuit provides the trigger pulse in period four which changes the receiver's mode to remote active. It also sets RLP high to prevent any interaction with the ATAC until this cycle of the receiver is complete. During the following period one, the receiver sends the command clock to the input register via ICs -JJ and -MM, and inputs the data word through ICs -JJ and -LL. Meanwhile, the ATAC is waiting for RLP to go low again. When it does, the ATAC closes the MC gate wih a DSP command and loads four sixteen-bit words with commands DOA, DOB, DOC, and DOD. Once the receiver word is stored in the ATAC, a DSTA command is sent to open the MC gate. When the operator has finished excution of the Receiver Control program and exits, the ATAC

sends the interface commands ADF and DSP to turn off the address line to the receiver and close the MC gate. The interface is now back in a stand-by status.

In order to set up the interface for operation with the KIM-1, the reset button must be pushed and the computer switch placed in the KIM-1 position. The reset button is unique to KIM-1 interface operation, and is necessary because of the use of the KIM-1's non-maskable interrupt. This interrupt is used to synchronize the KIM-1 with the receiver's command clock. Pressing the reset button places a momentary low on pin 3 of IC-KK, the flip-flop that controls the receiver's address line from the KIM-1. This resets the flip-flop and insures that the command clock output is disabled until required. ICs -JJ and -MM now transfer data from the KIM-1 and not the ATAC. The CCK7 line follows the address line from IC KK and gates the command clock off and on at the proper time. When the KIM-1 is ready to send a word to the receiver, it waits for a low on the RLP line. This line is connected to the maskable interrupt line. This low generates an interrupt and places the KIM-1 in the output program. This routine provides a trigger pulse for the trigger timing circuit and outputs the data synchronously with the command clock. The difference between the ATAC and KIM-1 actions of the interface is due to the position of the switch. The only function the interface serves is to provide reliable and compatible data to the appropriate device, whether it is receiver or

computer.

5. INPUT/OUTPUT REGISTERS

These two registers are used for the ATAC only. The registers were designated input or output by their related function with the receiver. They were constructed to provide the necessary, temporary storage while converting parallel and serial data back and forth. Both registers are connected to the PIO bus, with the major difference being the Tri-State connections of the serial to parallel, or output register.

The input register (Figure 8) was the easier to implement. It consists of eight 8-bit shift registers with parallel input and serial output. The parallel input comes from the ATAC's PIO bus, which is buffered by schottky inverters to reduce noise. The lines are connected to the ICs in such a way as to load words into two adjacent shift registers simultaneously. This is possible because the shift registers will only latch data in when their respective load line is low. By proper connection of the DIA-DID lines to pin 1 of the ICs, and coordinating the commands with the data, the output register can be completely and correctly filled. The command clock from the receiver is connected to pin 15 of each of the eight registers. When it is present, it clocks the data through the register exiting through pin 16 of IC-VV. From here, it goes through the control section

at IC-MM and on to the receiver.

The output register (Figure 9) performs the reverse operation. However, in order to separate it into words that are short enough for the ATAC, the data has to be multiplexed before it can be connected to the PIO bus. The Tri-State multiplexers, ICs -I through -L and -U through -X, and the required buffers, ICs -FE through -GG, were used to prevent interaction with the PIO bus when not in use. The timing here is more critical than in the input register system. Before the ATAC begins a read cycle from the output register, the clock signal to the register is stopped (DSP). This prevents the ATAC from reading non-stationary data. All the Tri-State multiplexers are addressed by connecting XAR bits 4 and 5 to pins 2 and 4 respectively. The commands DOA-DOD are ANDed together (NANDed and inverted) and the output connected to all the multiplexers as strobes at pins 1 and 15. When the ATAC reads a word, the XAR bits select the word and the strobe produces it during the microsecond when the PIO bus is available.

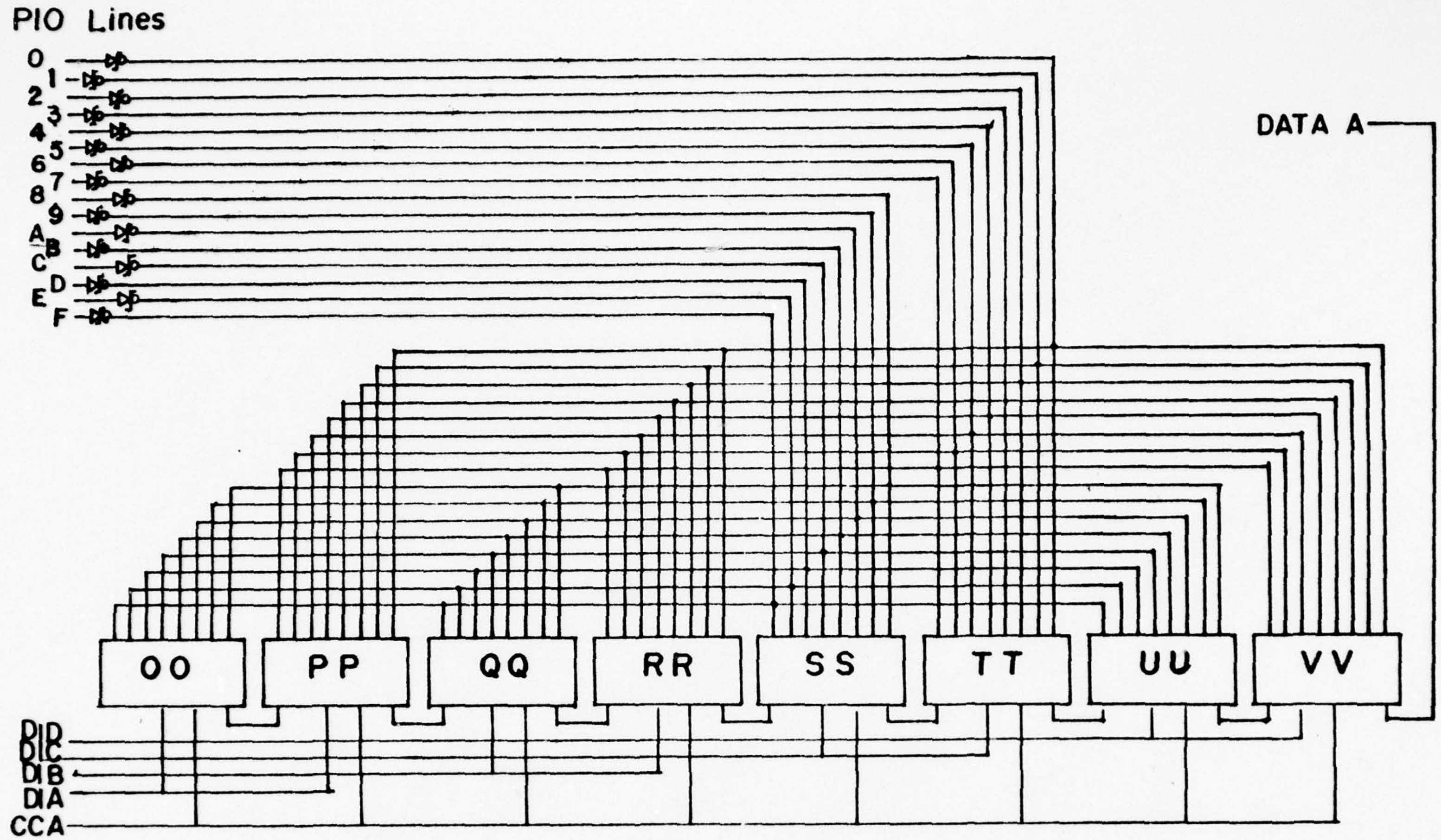


Figure 8
Input Register

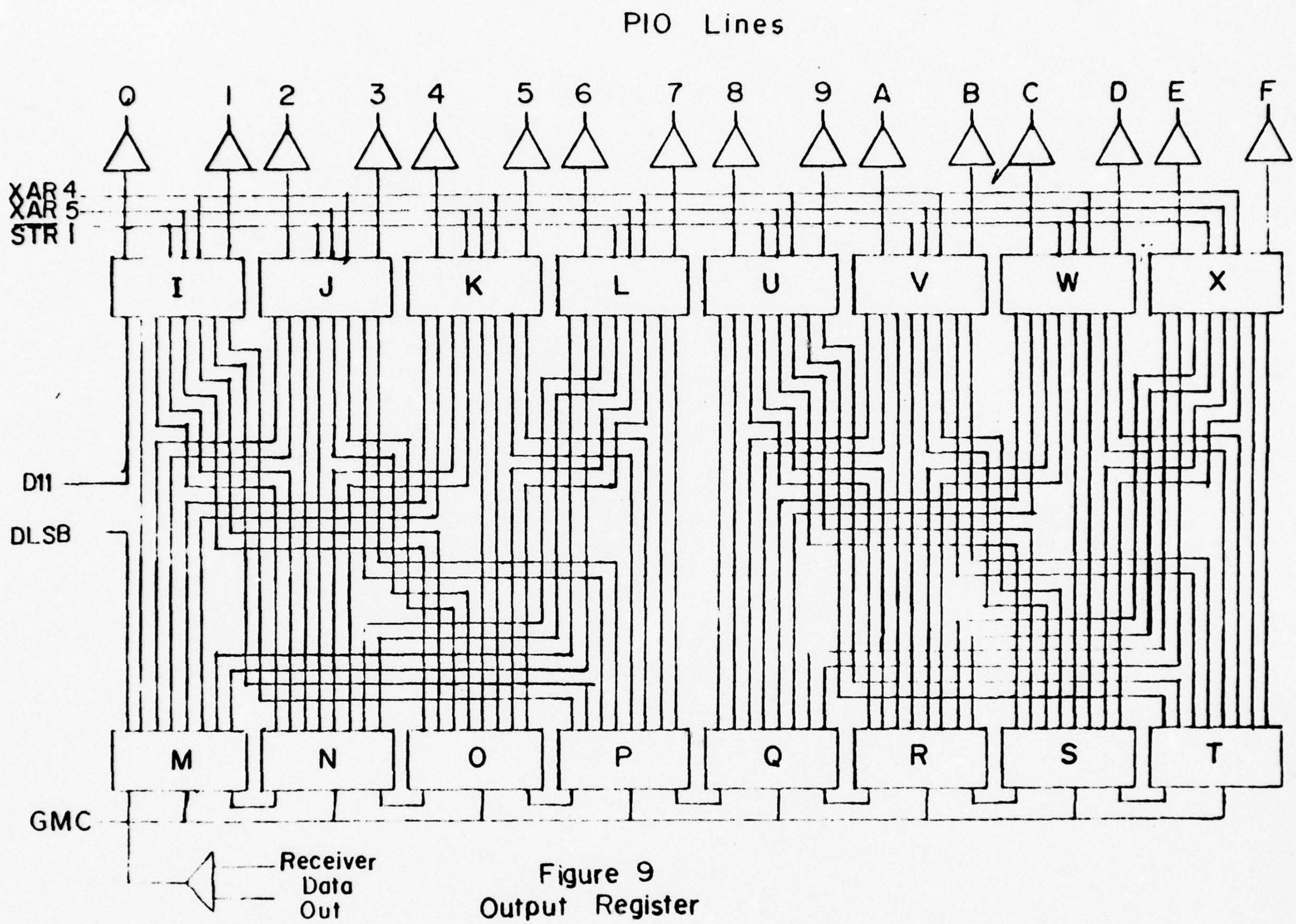


Figure 9
Output Register

V. THE PROGRAM

The ATAC program was written in two major sections; a system monitor and a control. The monitor is called the Main System and provides the operator the ability to program the ATAC from the operator's terminal. Receiver Control commands the interface and, therefore the receiver. Both programs were initially written prior to the construction of the interface, so many modifications were made using the Main System and its subroutines. After the interface was built and tested and the Receiver Control section modified to correctly contol the tuning of the receiver, the complete program was saved on paper tape (Appendix C). Operation of the computer is discussed in Appendix B and a sample run can be found in Appendix F.

A. THE MAIN SYSTEM

The Main System section consists of a small executive and a group of interconnected subroutines (Figure 10). The executive provides a basis for the subroutines when the receiver control program is not being executed. It is these subroutines that control the input and output to the operator terminal. The input routine is called KEYMR and the output routine, OUTPUT. OUTPUT converts correctly-formatted computer words into ASCII and displays them on the

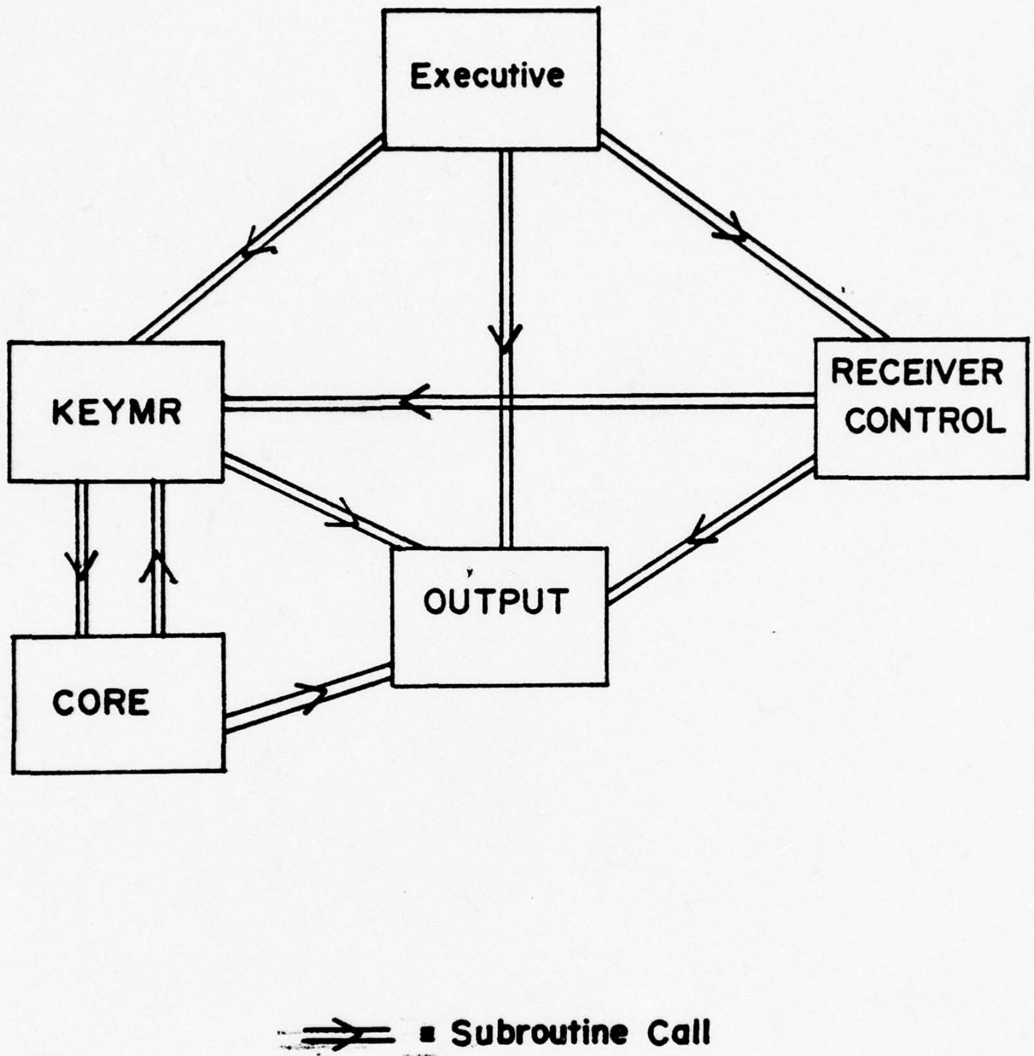


Figure 10
ATAC Program Block Diagram

I. CORE Commands

CO -- calls CORE from KEYMR.

a. DU 'address' -- displays 80 memory locations beginning with 'address'.

b. DT 'address' -- displays the contents of memory location 'address'.

c. CH 'address' 'value' -- Replaces the contents of memory at 'address' with 'value'.

d. CS 'address' -- Beginning at 'address', the contents of memory are replaced with the values typed on the lines following the command. Exit is accomplished by command DO.

e. DO -- Returns execution to CORE if in CS, otherwise returns to calling routine.

II. Receiver Control Commands

WJ -- Calls Receiver Control from the executive.

a. 0 -- Set-up - Routine to input values for entry into Receiver.

b. 1 -- Displays set-up control word.

c. 2 -- Displays last control word sent to receiver.

d. 3 -- Displays last control received from receiver.

e. 4 -- Sends set-up control word to receiver.

f. 5 -- Routine to input scan variables and execute a scan.

g. 6 -- Receive and Display control word from the receiver.

h. 7 -- Exit program and return to caller.

i. 8 -- Reinitialize program as if entering.

Table IV
AIAC Program Commands

terminal. KEYMR does the reverse, and stores the input in a buffer for use by the caller. KEYMR and OUTPUT were programmed to accept and display only uppercase letters, numerals, and a small number of needed symbols. But, because of the method employed to convert ASCII to machine code, it was found that each lower case letter entered from the keyboard was automatically mapped into its respective upper case twin. This relieves the operator of the responsibility of using the shift key. A part of the KEYMR, called CORE, is available for use by the operator to display and/or change sections of memory. The four available commands in this routine and their functions are displayed in Table IV. Care must be taken not to change memory locations which are used by the Main System. This could result in complete erasure of the ATAC's memory. Without KEYMR, OUTPUT, and CORE, or routines similiar to them, it would have been extremely difficult to perform any amount of toubleshooting or modification of the Receiver Control section.

B. RECEIVER CONTROL

This section of the system is a branch of the executive. Its main objective is to control both outputs and inputs of the interface from the operator's terminal. To assist those operators with little experience in this system, the Receiver Control section is equipped with uncomplicated

instructions and program safeguards. This produces almost foolproof operation but, it does so at the expense of program simplicity. Discussion of this section is separated into two parts. First a broad description of the complete section is discussed, followed by a detailed look at the two subroutines which interact with the interface.

When the Receiver Control program is entered, it performs five important actions. It initializes all necessary flags; enables the receiver and opens the MC gate; sends and receives a complete receiver word; and displays the instruction set to the operator. After this, it calls on KEYVR and waits for a command. When an input is delivered, the program checks its legality. If it is not a valid command, KEYVR is called again.

A valid command is a numeral between zero and eight (Table IV). These can be separated for discussion into three groups. The display group (0-3) inputs and exchanges information with the operator. The receiver group (4-6) performs operations with the receiver. The final group of commands (7-8) are used to exit or reinitialize the program. Group one has one input and three display commands. Command zero instructs the operator to input the parameters desired. It stores these parameters in memory in the display format, as opposed to control word format. Commands one, two, and three all display parameters. One displays the last parameters set-up by command zero. Two displays the last parameters sent to the receiver. Three displays the last

word received from the receiver. Commands seven and eight make up group three. Seven exits the program entirely and returns to the executive after disabling the receiver. Eight, on the other hand, returns the program to its beginning as if it had just been entered.

The remaining three commands are the most important. Group two commands control the actions of the interface. Command four converts the parameters set-up by command zero into control word format. It then calls the I/O subroutine described below, and outputs and inputs a receiver word. To merely receive a word from the receiver, command six is used. The program calls the input subroutine below and then exits to command three to display the parameters received. Command five scans a band of frequencies selected by the operator in search of a specified signal strength. All other parameters remain the same as those set-up by command zero.

With the exception of the instructions executed when entering and exiting Receiver Control, complete control of the interface and the receiver is resident in approximately forty computer instructions. These forty are grouped into the two subroutines WJR and WJS. WJS sends words to the receiver and WJR receives them. WJS loads the information and addresses to be sent to the receiver into the computer registers. The addresses are then matched to a word of data and sent to the interface input register. The routine now waits for the appropriate signal generated by RLP. When

this is received, a trigger command is sent to load the word into the receiver. At this point the routine checks the value of a counter. This test is to prevent the computer entering an infinite loop if either the interface or receiver is not turned on. If the test is unsatisfactory, the routine prints:

```
INFINITE LOOP
PLEASE CHECK RECEIVER AND INTERFACE
```

and reverts to operator control. If the test is satisfactory, the subroutine automatically continues to WJR. WJR loads another set of addresses into the computer registers. Here, a short wait for the RLP signal is necessary before any action is taken. The MC gate is closed immediately upon receipt of this signal. The receiver word is then loaded into the ATAC by outputting the address on the XAP lines and reading the data on the PIO lines. When the complete word is received, the MC gate is opened. At this point it is necessary to test for command six. This test determines whether the computer is sending and receiving or only receiving. If the execution of both WJS and WJR is being performed, a comparison between the word sent and the word received is necessary. This comparison is skipped if the computer is only executing WJR (command six). The first three control words sent by WJS and received by WJR are used for this comparison, when it is performed. If

any words differ, the computer returns to WJS to repeat the cycle until one of two conditions are met: either the words match or the WJS counter test discussed earlier fails. If the words match, WJP continues on to convert the received control words into the display format and then returns to the caller.

VI. RECOMMENDATIONS

The system as it stands now is but a beginning. Additions and modifications for future work should include; A/D converters for the receiver outputs; Morse and/or teletype decoders; and an expansion of the computer program. Implementation of either of the first two implies the third. There are some operator assistance program modifications that need to be made. The two that come immediately to mind are (1) a method to abort the scan routine from the operator's console, and (2) the ability to change individual parameters in addition to the set-up command already located in the program. Addition of the A/D converters implies a program increase to decode and process this new data. Switching routines and probably some hardware will be needed for the decoders. The capabilities of the system are limited only by the abilities of the operator and programmer.

VII. CONCLUSION

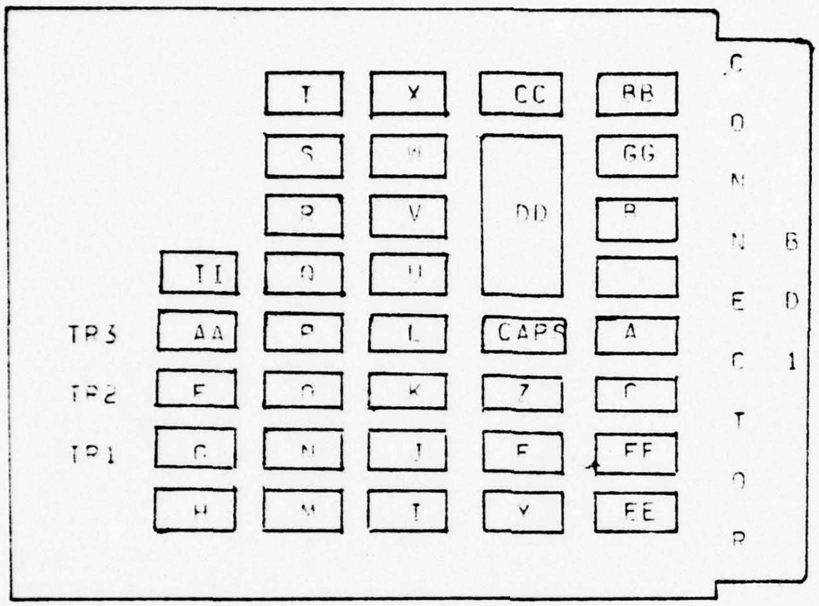
As long as the computer requires only that data obtained from the receiver's word, the interface is flexible enough to provide reliable results. At this time there are no known "bugs" in either the interface or the program. Both have been thoroughly tested to provide the operator with the most dependable system possible.

APPENDIX A

INTERFACE WIRING

A. Board 1

Integrated circuit locations (from Top of board).



Integrated Circuit

pin	A 8820	B 8820	C 8830	E 7476	F 7404	G 7400	H 74157
1	BD1-M	BD1-K	C-2/Z-3	VCC	M-3	BD2-E	DD-14
2	nc	nc	C-1/C-3	DD-8	H-3	Y-9	TI-14
3	BD1-L	BD1-J	C-2/C-4	DD-15	A-6/Y-8	F-11	F-2
4	nc	nc	C-3	VCC	G-5	E-11	I-6
5	nc	nc	BD1-F	VCC	AA-6	F-4	nc
6	F-3/Y-8	M-1	BD1-H	VCC	G-12	F-9	nc
7	GRD	GRD	GRD	DD-7	GRD	GRD	GRD
8	nc	nc	nc	DD-6	T-8	nc	nc
9	nc	nc	nc	VCC	G-6	nc	nc
10	nc	nc	nc	nc	II-3	nc	nc
11	nc	nc	nc	G-4	G-3	F-13	nc
12	nc	nc	nc	VCC	I-15	F-6	nc
13	nc	nc	nc	GRD	G-11	DD-14	GRD
14	VCC	VCC	VCC	nc	VCC	VCC	VCC
15	XXXXXXX	XXXXXXX	XXXXXXX	BD1-Y	XXXXXXX	XXXXXXX	XXXXXXX
16	XXXXXXX	XXXXXXX	XXXXXXX	VCC	XXXXXXX	XXXXXXX	XXXXXXX

Integrated Circuit

pin	I 7214	J 7214	K 7214	L 7214	M 74164	N 74164
1	X-15	I-15/J15	J-15/K15	K-15/L15	B-6/M-2	M-13/N-2
2	DD22/J-2	I-2/K-2	J-2/L-2	K-2/U-2	M-1	N-1
3	S-3	S-5	S-10	S-12	F-1	U-6
4	Q-3	Q-5	Q-10	Q-12	I-10	U-10
5	O-3	O-5	O-10	O-12	J-6	V-6
6	H-4	M-5	M-10	M-12	J-10	V-10
7	EE-1	FE-5	EF-11	FF-1	GRD	GRD
8	GRD	GRD	GRD	GRD	N-8	M-8/O-8
9	EE-3	FE-9	EF-13	FF-3	VCC	VCC
10	M-4	M-6	M-11	M-13	K-6	W-6
11	O-4	O-6	O-11	O-13	K-10	W-10
12	Q-4	Q-6	Q-11	Q-13	L-6	X-6
13	S-4	S-6	S-11	S-13	L-10	X-10
14	DD23/J14	K-14/I14	J-14/L14	K-14/U14	VCC	VCC
15	F-12/J-1	J-1/K-1	K-1/L-1	L-1/U-1	XXXXXXXX	XXXXXXXX
16	VCC	VCC	VCC	VCC	XXXXXXXX	XXXXXXXX

pin	O 74164	P 74164	Q 74164	R 74164	S 74164	T 74164
1	N-13/O-2	O-13/P-2	P-13/Q-2	Q-13/R-2	R-13/S-2	S-13/T-2
2	O-1	P-1	Q-1	R-1	S-1	T-1
3	I-5	U-5	I-4	U-4	I-3	U-3
4	I-11	U-11	I-12	U-12	I-13	U-13
5	J-5	V-11	J-4	V-4	J-3	V-3
6	J-11	V-11	J-12	V-12	J-13	V-13
7	GRD	GRD	GRD	GRD	GRD	GRD
8	N-8/P-8	O-8/Q-8	P-8/P-8	Q-8/S-8	R-8/T-8	S-8/F-8
9	VCC	VCC	VCC	VCC	VCC	VCC
10	K-5	W-5	K-4	W-4	K-3	W-3
11	K-11	W-11	K-12	W-12	K-13	W-13
12	L-5	X-5	L-4	X-4	L-3	X-3
13	L-11	X-11	L-12	X-12	L-13	X-13
14	VCC	VCC	VCC	VCC	VCC	VCC

Integrated Circuit

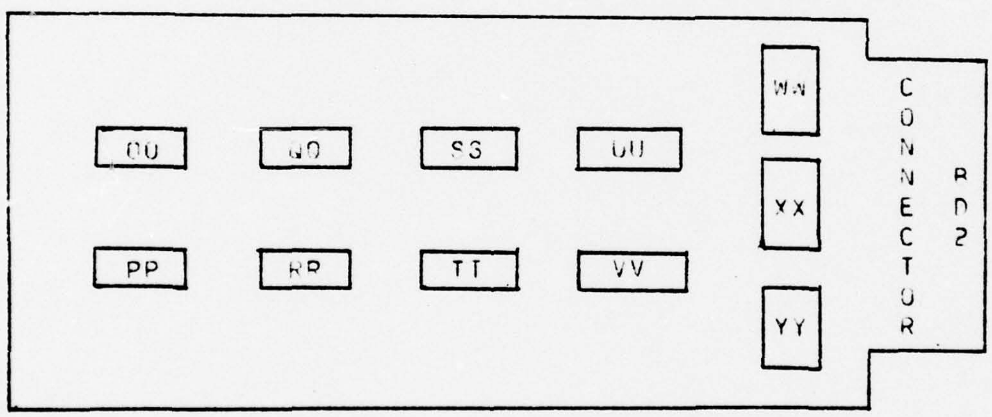
	U	V	W	X	Y	Z
pin	7214	7214	7214	7214	556	555
1	L-15/U15	U-15/V15	V-15/W15	W-15/X15	Y2/Tr-1A	GRD
2	L-2/V-2	U-2/W-2	V-2/X-2	W-2	Y-1/HH-6	BD1-E
3	T-3	T-5	T-10	T-12	HH-5	C-1
4	R-3	R-5	R-10	R-12	VCC	VCC
5	P-3	P-5	P-10	P-12	BD1C/II1	HH-1
6	N-3	N-5	N-10	N-12	Y-9	HH-2/Z-7
7	FF-5	FF-11	GG-1	GG-5	GRD	Z6/Tr-3A
8	GRD	GRD	GRD	GRD	A-6/F-3	VCC
9	FF-9	FF-13	GG-3	GG-9	Y-6	XXXXXXXX
10	N-4	N-6	N-11	N-13	VCC	XXXXXXXX
11	P-4	P-6	P-11	P-13	HH-4	XXXXXXXX
12	R-4	R-6	R-11	R-13	Y-13/HH4	XXXXXXXX
13	T-4	T-6	T-11	T-13	Y12/Tr2A	XXXXXXXX
14	L-14/V14	U-14/W14	V-14/X14	W-14	VCC	XXXXXXXX
15	U-1/V-1	V-1/W-1	W-1/X-1	X-1/1-1	XXXXXXXX	XXXXXXXX
16	VCC	VCC	VCC	VCC	XXXXXXXX	XXXXXXXX

	AA	BB	CC	EE	FF	GG	HH	II
pin	7420	74s04	74s04	7407	7407	7407	CAPS	7476
1	DD-10	CC-6	BD1-17	I-7	L-7	W-7	Z-5	Y-5
2	DD-11	DD-18	DD-23	BD1-1	BD1-7	BD1-13	Z-6	VCC
3	nc	BD1-21	nc	I-9	L-9	W-9	Y-11	F-10
4	DD-9	BB-5	nc	BD1-2	BD1-8	BD1-14	Y-12	VCC
5	DD-13	BB-4	BD1-T	J-7	U-7	X-7	Y-3	nc
6	F-5	DD-19	BB-1	BD1-3	BD1-9	BD1-15	nc	nc
7	GRD	GRD	GRD	GRD	GRD	GRD	Y-2	nc
8	nc	DD-20	nc	BD1-4	BD1-10	BD1-16	GRD	nc
9	nc	BD1-20	nc	J-9	U-9	X-9	GRD	nc
10	nc	DD-21	nc	BD1-5	BD1-11	nc	GRD	nc
11	nc	BD1-19	nc	K-7	V-7	nc	GRD	nc
12	nc	DD-22	nc	BD1-6	BD1-12	nc	GRD	nc
13	nc	BD1-16	nc	K-9	V-9	nc	GRD	GRD
14	VCC	VCC	VCC	VCC	VCC	VCC	GRD	H-2
15	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	nc
16	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	GRD

Integrated Circuit

pin		DD 74154 pin	
1	BD1-P	13	AA-5
2	BD1-X	14	G-13/H-1
3	BD1-W	15	nc
4	BD1-V	16	nc
5	BD1-U	17	F-3
6	E-8	18	BB-2
7	E-7	19	BB-6
8	E-2	20	BB-8
9	AA-4	21	BB-10
10	AA-1	22	BB-12/I-2
11	AA-2	23	CC-2/I-14
12	GRD	24	VCC

II. Board 2
Integrated Circuit locations (from Top of board)



Integrated Circuit

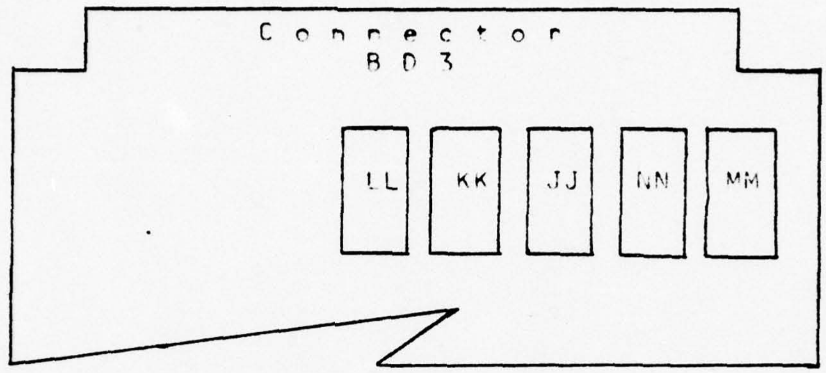
pin	OO 74165	PP 74165	QQ 74165	RR 74165	SS 74165	TT 74165
1	BD2-A	BD2-A	BD2-B	BD2-B	BD2-C	BD2-C
2	GRD	GRD	GRD	GRD	GRD	GRD
3	WW-2	YY-6	WW-2	YY-6	WW-2	YY-6
4	WW-12	YY-4	WW-12	YY-4	WW-12	YY-4
5	WW-4	YY-2	WW-4	YY-2	WW-4	YY-2
6	WW-10	YY-10	WW-10	YY-10	WW-10	YY-10
7	nc	nc	nc	nc	nc	nc
8	GRD	GRD	GRD	GRD	GRD	GRD
9	PP-10	QQ-10	RR-10	SS-10	TT-10	UU-10
10	VCC	OO-9	PP-9	QQ-9	RR-9	SS-9
11	XX-2	XX-4	XX-2	XX-4	XX-2	XX-4
12	XX-12	XX-6	XX-12	XX-6	XX-12	XX-6
13	WW-8	XX-8	WW-8	XX-8	WW-8	XX-8
14	WW-6	YY-12	WW-6	YY-12	WW-6	YY-12
15	BD2-21	BD2-21	BD2-21	BD2-21	BD2-21	BD2-21
16	VCC	VCC	VCC	VCC	VCC	VCC

pin	UU 74165	VV 74165	WW 74s04	XX 74s04	YY 74s04
1	BD2-D	BD2-D	BD2-17	BD2-10	BD2-4
2	GRD	GRD	OO-3 *	OO-11 *	PP-5 *
3	WW-2	YY-6	BD2-15	BD2-9	BD2-3
4	WW-12	YY-4	OO-5 *	PP-11 *	PP-4 *
5	WW-4	YY-2	BD2-13	BD2-8	BD2-2
6	WW-10	YY-10	OO-14 *	PP-12 *	PP-3 *
7	nc	nc	GRD	GRD	GRD
8	GRD	GRD	OO-13 *	PP-13 *	nc
9	VV-10	BD2-K	BD2-12	BD2-7	nc
10	TT-9	UU-9	OO-6 *	nc	PP-6 *
11	XX-2	XX-4	BD3-14	nc	BD2-5
12	XX-12	XX-6	OO-4 *	OO-12 *	PP-14 *
13	WW-8	XX-8	BD2-16	BD2-11	BD2-6
14	WW-6	YY-12	VCC	VCC	VCC
15	BD2-21	BD2-21	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX
16	VCC	VCC	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX

* - bus connection - only first connection shown

C. Board Three

Integrated circuit locations (from Top of board)



Integrated Circuit

	JJ	KK	LL	MM	NN
pin	74157	7476	8830	74126	8820
1	BD3-1	VCC	LL-2/JJ-7	BD3-1	BD3-5
2	KK-15	BD3-11	LL-1/LL-3	BD3-17	nc
3	BD3-6	BD3-12/20	LL-2/LL-4	BD3-16	BD3-4
4	LL-10	nc	LL-3	JJ-12	nc
5	BD3-8	VCC	BD3-7	GRD	nc
6	BD3-9	nc	BD3-10	BD3-16	MM-9
7	LL-1	nc	GRD	GRD	GRD
8	GRD	nc	BD3-19	BD3-2	nc
9	BD3-13	nc	BD3-18	NN-8	nc
10	BD3-14	nc	LL11/JJ-4	BD3-1	nc
11	nc 5	nc	LL12/LL10	BD3-3	nc
12	MM13/MM-4	nc	LL13/LL11	MM-9	nc
13	GRD	GRD	LL-12	JJ-12	nc
14	KK-15	nc	VCC	VCC	VCC
15	GRD	JJ-2/JJ14	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX
16	VCC	nc	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX

D. Connectors

Circuit Board Edge-connectors

	BD1	BD2	BD3
1	EE-2/BD2-10/CN1-2	GRD	SW1/JJ-1/MM-10
2	EE-4/BD2-11/CN1-3	YY-5/BD1-13	MM-8/BD2-21
3	EF-6/BD2-12/CN1-4	YY-3/BD1-14	MM-11/CN3-1
4	EE-8/BD2-13/CN1-5	YY-1/BD1-15	NN-2/CN2-2
5	EE10/BD2-17/CN1-6	YY-11/BD1-16	NN-1/CN2-3
6	EE12/BD2-16/CN1-7	YY-13/BD1-12	JJ-3/BD1-Y
7	FF-2/BD2-15/CN1-8	XX-9/BD1-11	LL-5/CN2-10
8	FF-4/BD2-14/CN1-9	XX-5/BD1-10	JJ-5/CN3-2
9	FF-6/BD2-9/CN1-10	XX-3/BD1-8	JJ-6/BD2-K
10	FF-8/BD2-8/CN1-11	XX-1/BD1-1	LL-6/CN2-11
11	FF10/BD2-7/CN1-12	XX-13/BD1-2	KK-2/CN3-3
12	FF12/BD2-6/CN1-13	WW-9/BD1-3	KK-3/CN3-4
13	GG-2/BD2-2/CN1-25	WW-5/BD1-4	JJ-9/BD1-F
14	GG-4/BD2-3/CN1-24	WW-11/BD1-8	JJ-10/BD1-P
15	GG-6/BD2-4/CN1-23	WW-3/BD1-7	JJ-11/CN3-5
16	GG-8/BD2-5/CN1-22	WW-13/BD1-6	nc
17	CC-1/CN1-11	WW-1/BD1-5	nc
18	BB-13/CN1-17	nc	LL-9/CN2-12
19	BB-11/CN1-19	nc	LL-8/CN2-11
20	BB-9/CN1-16	nc	KK-3/RESET
21	BB-3/CN1-20	OO-15/BD3-2	nc
22	nc	GRD	VCC
A	GRD	OO-1/BD1-X	GRD
B	nc	QQ-1/BD1-W	nc
C	II-14/CN3-6	SS-1/BD1-V	nc
D	nc	UU-1/BD1-U	nc
E	Z-2/BD3-13	nc	nc
F	C-5/CN2-9	nc	nc
H	C-6/CN2-8	nc	nc
J	B-3/CN2-7	nc	nc
K	B-1/CN2-6	nc	nc
L	A-3/CN2-5	nc	nc
M	A-1/CN2-4	nc	nc
N	nc	nc	nc
P	DD-1/BD3-14	nc	nc
R	nc	nc	nc
S	nc	nc	nc
T	CC-5/CN1-14	nc	nc
U	DD-5/BD2-D	nc	nc
V	DD-4/BD2-C	nc	nc
W	DD-3/BD2-B	nc	nc
X	DD-2/BD2-A	nc	nc
Y	E-15/BD3-6	nc	nc
Z	VCC	nc	nc

Cabinet Connectors

pin	CN1	CN2	CN3
1	GRD	GRD	BD3-3 "CCK"
2	BD1-1 "PIO 0"	BD3-4 "CC - "	BD3-8 "DATA K"
3	BD1-2 "PIO 1"	BD3-5 "CC + "	BD3-11 "KAC"
4	BD1-3 "PIO 2"	BD1-M "MC - "	BD3-12 "KAF"
5	BD1-4 "PIO 3"	BD1-L "MC + "	BD3-15 "TRK"
6	BD1-5 "PIO 4"	BD1-K "DO - "	BD1-3 "PLP"
7	BD1-6 "PIO 5"	BD1-J "DO + "	nc
8	BD1-7 "PIO 6"	BD1-H "TR - "	nc
9	BD1-8 "PIO 7"	BD1-F "TR + "	nc
10	BD1-9 "PIO 8"	BD3-7 "DI - "	nc
11	BD1-10 "PIO 9"	BD3-10 "DI + "	nc
12	BD1-11 "PIO 10"	BD3-19 "AD - "	nc
13	BD1-12 "PIO 11"	BD3-18 "AD + "	nc
14	BD1-T "IOD"	nc	GRD
15	nc	nc	nc
16	BD1-17 "XAR 4"	nc	nc
17	BD1-18 "XAR 5"	nc	nc
18	BD1-20 "XAR 9"	nc	nc
19	BD1-19 "XAR 8"	nc	nc
20	BD1-21 "XAR 13"	nc	nc
21	nc	nc	nc
22	BD1-16 "PIO-15"	nc	nc
23	BD1-15 "PIO-14"	nc	nc
24	BD1-14 "PIO-13"	nc	nc
25	BD1-13 "PIO-12"	nc	nc

E. Discrete Components

Capacitors

.01 uF	HH-1/HH-14
.2 uF	HH-2/HH-13
.20 uF	HH-3/HH-12
.01 uF	HH-4/HH-11
.01 uF	HH-5/HH-10
.47 uF	HH-7/HH-8

Resistors

Trimmer

	1	2	3
A	Y-1	Y-13	Z-7
B	VCC	VCC	VCC
C	VCC	VCC	VCC

APPENDIX B
ATAC OPERATING INSTRUCTIONS

Power Up
    Turn on front panel power then turn on power supplies.

Power Down
    'Halt'
    'Master Clear'
    Power off to supplies, power off to control panel.

Run Program
    'Master Clear'
    Dial 'IMR'
    'AUX REG'
    'ENTER' (associated with AUX REG)
    'MEMORY'
    Set start address +1 in keyboard (Hexadecimal)
    'PCR'
    'ENTER' (associated with PCR)
    'RUN'

Stop a Program
    'HALT'

Read Memory (from front panel)
    'HALT'
    Set desired address in key board
    Select 'MAR'
    'ENTER' (associated with MAR)
    'INC' (increment)
    'DEC' (decrement)
    Address is displayed above MAR key, data is displayed in red LEDs above MEMORY key.
    Use INC or DEC as necessary to arrive at memory location desired.

Write into Memory (from front panel)
    'HALT'
    Set address desired as described in Read Memory.
    Set desired data into keyboard
    'ENTER' (associated with MEMORY)
    Value in keyboard will be entered into either Memory (MEMORY) or A computer Register (FILE).

Bootstrap Load (paper tape)

'HALT'

'MASTER CLEAR'

'AUX REG'

Dial 'IMR'

'ENTER' (associated with AUX REG)

'MEMORY'

Set 0001 in keyboard

(0001 = Load, 0002 = Verify only)

'RUN'

At end of tape check program status lights (red LEDs below PCR and MAR pushbuttons)

0000 = Load good
FFFE = Parity error
FFFD = Verify error

APPENDIX C

ATAC PROGRAM ASSEMBLY

Assembly of a program is divided into five parts; writing, producing absolute deck on IBM 360, conversion of absolute deck into ATAC format, punching paper tape, and loading ATAC.

A. Writing the program.

Programs for the ATAC must be written in the assembly language described in ATAC manuals Volumes One, and Eight. The finished program must be placed on cards for the IBM 360 in the following format:

```
LABEL | OPERATION | VARIABLE | COMMENT
      |___________|__________|
             BLANKS
```

B. Producing an absolute deck

The first step is to load the assembler on to the IBM 360 from magnetic tape. This is done by executing program A in Appendix E. This transfers the program from tape to disk and saves it for one year. Once the assembler is stored the

following cards placed in the front of a program written following the instructions in I above will produce an absolute deck and a print-out of the program.

```
//ATACASSM JOB (0729,0194,0052),'CCH ATAC ASSEM,',TIME=1
//ASSEM     EXEC PGM=APSS,REGION=220K
//STEPLIB  DD   DSN=S0729.ATAC.ONE,UNIT=3330,
//                   VOL=SER=DISK02,DISP=SHR
//FT06F001 DD    SYSOUT=A
//FT07F001 DD    SYSOUT=B
//FT05F001 DD    DDNAME=SYSIN
//FT08F001 DD    UNIT=SYSDA,SPACE=(CYL,1)
//FT09F001 DD    UNIT=SYSDA,SPACE=(CYL,(7,2)),
//              DCB=(RECFM=VBS,BLKSIZE=7180,LRECL=92)
//FT10F001 DD    UNIT=SYSDA,SPACE=(CYL,(7,2)),
//              DCB=(RECFM=VBS,BLKSIZE=4204,LRECL=42)
//FT20F001 DD    UNIT=SYSDA,SPACE=(CYL,(7,2)),
//              DCB=(RECFM=VBS,BLKSIZE=2004,LRECL=500)
//SYSPRINT DD    SYSOUT=A
//SYSIN    DD    *
$JOB
$ASSEM
          IDT    ATAC
```

(place written program here.)

```
          END
$BASE
$LOAD      P
$END
```

The absolute deck is in the form:

```
0500169c0009adbc3109bc9c3109c8bc7109c09c7109d8b60309bbd932/
                                                /e10100009c015a
0510160?f49c0109f6ed0008aee1010a02ed000230e10109f7ed0007ae/
                                                /c1070509201258
```

which must be translated for the ATAC. The memory location of the first word is located in the first four columns.

Columns five and six contain the number of word fields on the card. The assembled program is located in columns 7 - 70. The remaining two columns are parity.

C. Conversion

The absolute deck received from the IBM 360 is loaded into the PDP-11. After the data from the cards is checked, the conversion program (convert 'filename' 'filename') can be executed. (Program C in Appendix E)

D. Punching Paper Tape

This code must then be transferred to the PDP-11 (A) where a paper tape can be punched. Here, the command to punch a tape is:

```
cat 'filename' >/dev/ptp
```

E. Loading the ATAC

In order to load a tape the RS232 connector must be connected to the Paper Tape reader and the reader set to 1200 baud. The tape is loaded by following the instructions in Appendix B.

APPENDIX D

SAMPLE ATAC OUTPUT

Operator inputs are underlined.

```
Operator Display                          *Comments

EXEC                                      *Executive echos
+JDKDKJFJjjnmun                           *entries other than
JDKDKJFJJJNMUH                            *commands

EXEC
+CO                                       *Entry into CORE

CORE
+CH 0F00 0900                             *Location 0F00
0F00  0900                                *changed to 0900

CORE
+DI 0F00
0F00  0900

CORE
+CS 0F00                                  *Locations  0F00 to 0F03
+0256                                     *changed

+0123

+4567

+DO                                       *completion of change
0F00  0256
0F01  0123
0F02  4567

CORE
+DO                                       *Exit from CORE

+WJ                                       *Entry into Receiver
0=SET-UP                                  *Control
1=DISPLAY TENTATIVE
2=DISPLAY CONTROL
3=DISPLAY RECEIVED
4=ENTER TENTATIVE
5=SCAN
```

```
6=RECEIVE CONTROL
7=DONE
8=REINITIALIZE

RECEIVER CONTROL
+0

FREQ(HZ)

+1240000
DETECT MODE
0=AM
1=FM
2=BFO FIXED
3=BFO VARIABLE
4=ISB
5=USB
6=LSB
7=AM-NL

+0
GAIN MODE
0=HOLD AGC
2=NORMAL AGC
3=MANUAL AGC

+0
IF BANDWIDTH
1=500 HZ
2=2 KHZ
3=4 KHZ
4=8 KHZ

+4
RF GAIN
(PERCENTAGE)

+88

RECEIVER CONTROL
+1
FREQ = 1240000 HZ
GAIN MODE = HOLD AGC
IF BANDWIDTH = 8 KHZ
DETECT MODE = AM
BFO FREQ = 455000 HZ
RF GAIN = 88%

RECEIVER CONTROL
+2
```

```
FREQ = 550000 HZ
GAIN MODE = NORMAL AGC
IF BANDWIDTH = 8 KHZ
DETECT MODE = AM
BFO FREQUENCY = 455000 HZ
RF GAIN = 85%

RECEIVER CONTROL
+3
FREQ = 550000 HZ
GAN MODE = NORMAL AGC
IF BANDWIDTH = 8 KHZ
DETECT MODE = AM
BFO FREQUENCY = 455000 HZ
RF GAIN = 85%
SIGNAL STRENGTH = 66%

RECEIVER CONTROL
+4

RECEIVER CONTROL
+5
SCAN
START FREQ IN HZ

+1000000
END FREQ IN HZ

+1008000
FREQ INCREMENT IN HZ

+1000
SIGNAL STRENGTH %

+67
FREQ = 1001000
GAIN MODE = HOLD AGC
IF BANDWIDTH = 8 KHZ
DETECT MODE = AM
BFO FREQUENCY = 455000 HZ
RF GAIN = 88%
SIGNAL STRENGTH = 72%

RECEIVER CONTROL
+7                                  *Exit from
EXEC                                *Receiver Control
+
```

APPENDIX E
CONVERSION PROGRAMS FOR THE ASSEMBLER

A. This program is run on the IBM-360 to transfer the ATAC assembler from tape ATI-006 to Disk and stores it there for one year.

```
// [GREEN JOB CARD]
//SYSPRINT DD    SYSOUT=A
//SYSUT1    DD    UNIT=SYSDA,SPACE=(TRK,(40),,CONTIG)
//DA1       DD    UNIT=2314,DSN=S0729.ATAC.ONE,
//                SPACE=(TRK,(50,10,10),,CONTIG),
//                DISP=(NEW,KEEP),VOL=SER=SPOOL3
//T1TAPE DD UNIT=(2400,,DEFER),DISP=(NEW,PASS),
//                 LABEL=(3,SL,,IN),
//                DCB=(DEN=2,BLKSIZE=800,LRECL=80,RECFM=FB),
//                VOL=SER=ATI006
//SYSIN     DD    *
          COPY    PDS=ATI.APSS.LOADLIB,TO=2314=SPOOL3,
                  FROMDD=T1TAPE,FROM=2400=(ATI006,3),
                  RENAME=S0729.ATAC.ONE
/*
//BUILD     EXEC PGM=IEWL,REGION=150K,
//            PARM='OVLY,XREF,LET,LIST,SIZE=(256K,20480)'
//SYSPRINT DD    SYSOUT=A
//LIBRARY DD DSN=S0729.ATAC.ONE,UNIT=2314,VOL=SER=SPOOL3,
//                DISP=SHR
//SYSLIB DD DSNAME=SYS1.FORTLIB,DISP=SHR
//SYSLMOD DD DSNAME=S0729.ATAC.ONE,
//                 UNIT=3330,VOL=SER=DISK02,
//                DISP=(NEW,KEEP),LABEL=RETPD=360,
//                SPACE=(CYL,(5,1,2),RLSE)
//SYSUT1 DD UNIT=SYSDA,SPACE=(TRK,(19,19),,CONTIG),
//                SEP=SYSLMOD
//SYSLIN    DD    *
 INCLUDE LIBRARY(PMUDL)
 CHANGE MSIM(IHESAPD)
 INCLUDE LIBRARY(APSSMON)
 INCLUDE LIBRARY(MSIM4,ASEM5,SIM16A,SIMTR1,SIMIO1,GUL)
 INCLUDE LIBRARY(XPLMON)
 OVERLAY A1
 INSERT MSIMUL,*MSIMULA,IHENTRY,IHESAP
 INSERT MINT,IN,OUT
 INSERT IHEDBN,IHEXID
```

```
 INSERT IHEBSM,IHECSM
 INSERT IHEBSK,IHEIOX,IHEIOP,IHEDIO,IHEDOB
 INSERT IHEDIB,IHEDOA,IHEIOB
 INSERT IHEIOA,IHEOCL
 INSERT IHEBSD,IHEBSF
 INSERT IHEJXS
 INSERT IHEOSD,IHEOST,IHEBST
 INSERT IHEVPF,IHEDMA,IHEVFB
 INSERT IHEDNC,IHEVFD,IHEVFA,IHEVPD,IHEVPB,IHEVSC
 INSERT IHEVSD,IHEVFE,IHEDCN,IHEUPB
 INSERT IHEVFC,IHEVPE,IHEVPG,IHEVQB,IHEVGC
 INSERT IHEABN,IHEIOD,IHEIOF,IHEPRT,IHEVQA,IHESPRT
 INSERT IHEBEG,IHEERR,IHESIZ
 INSERT MISET
 OVERLAY A1
 INSERT ASSEM,REWIND,REW72,DSKOUT,CARDIN,DISKIN,ERPRT,PRIADD
 INSERT WRDATA,PRTCOM,PRINOR,WRITEX,REFTIT,PREF,EPTIT
 OVERLAY A1
 INSERT PARMRD,PRESIM
 OVERLAY A1
 INSERT SMLTR,NRMTRM,STPTSM,IPAGE
 INSERT RDCPD,ABNRMT,ARTHER,TRACE,HGRAM,HGRAMI,HGRAMS
 INSERT IOINIT,ACTIVE,STMTIM
 INSERT DEVDTA,ACT,TIME,INT,RAND,DEADT,DEBUG
 OVERLAY A2
 INSERT LEVEL,DMATOI,DMAIOA,DMAIOD,RIOIO
 INSERT REMACT,DMA,DMATM,RIO,RIOTM,RIOINT,INTOLY,DMAINT
 INSERT DTRAN,PUTACT,RANDOM
 OVERLAY A1
 INSERT HGPRNT
 OVERLAY A1
 INSERT LOADER
 OVERLAY A1
 INSERT LINK,ENTEXT,SLEH
 OVERLAY A1
 INSERT PLATAC,IOPACK
 OVERLAY $OBJECT(REGION)
 INSERT OBJECT,INIT,LIB,RCALPH,RCHEX,RCINT
 INSERT MDATE
 OVERLAY $DUMP(REGION)
 INSERT SMDUMP,PAGE
 ENTRY MAIN
 NAME APSS
/*
//            EXEC PGM=IEBCOPY
//SYSPRINT DD    SYSOUT=A
//SYSUT1   DD    DISP=SHR,UNIT=2314,VOL=SER=SPOOL3,
//               DSN=S0729.ATAC.ONE
//SYSUT2 DD DISP=(NEW,PASS),UNIT=3330,VOL=SER=DISK02,
//            DSN=S0729.ATAC.TWO,
```

```
//             SPACE=(13030,(61,0,14),RLSE),
//                DCB=(RECFM=U,BLKSIZE=13030),
//                ,LABEL=RETPD=360
//SYSUT3    DD    UNIT=SYSDA,SPACE=(TRK,(20,5))
//SYSUT4    DD    UNIT=SYSDA,SPACE=(TRK,(20,5))
//SYSIN     DD    *
            COPY OUTDD=SYSUT2,INDD=SYSUT1
```

B. This program converts the IBM-360 absolute deck into correct format for the ATAC.

```
main (argc, *argv)
    int argc;
    char *argv [];
    {register crctr, index, jndex;
     int stchr;
     int tmpry [73];
     struct buffr
        {int fldes;
         int nleft;
         char *nextp;
         char *buffs [512];
        } bufin, bufot, *pntr1, *pntr2;
     stchr = 020;
     if (argc != 3)
        {printf ("Calling arguments are incorrect#");
         exit (0);
        }
     bufin.fldes = open (argv [1], 0);
     if (bufin.fldes < 0)
        {printf ("Cannot open %s#", argv [1]);
         exit (0);
        }
     pntr1 = &bufin.fldes;
     bufot.fldes = creat (argv [2], 0777);
     if (bufot.fldes < 0)
        {printf ("Cannot open %s#", argv [2]);
         exit (0);
        }
     pntr2 = &bufot.fldes;
     putc (stchr, pntr2);
     while (crctr >= 0 && index <= 72)
          tmpry [index++] = (crctr = getc (pntr1));
     index =- 3;
     jndex = 0;
     while (jndex < 4 && jndex < index)
```

```
     putc (tmpry [jndex++], pntr2);
  jndex = jndex + 2;
  while (crctr >= 0)
     {while (jndex < index)
        {if (tmpry [jndex] == '#')
              jndex++;
           else
              putc (tmpry [jndex++], pntr2);
        }
      index = 0;
      while (crctr >= 0 && index <= 72)
          tmpry [index++] = (crctr = getc (pntr1));
      index =- 3;
      jndex = o;
     }
  putc (stchr, pntr2);
  fflush (pntr2);
  close (bufin.flces);
  close (bufot.flces);
}
```

C. The following program executes the program above and converts the output into the correct code.

```
atac $1 $2
if ! -r $2 exit
mv $2 temp2
tr "[0*]" "[040*]" <temp2 >temp1
tr "[1*]" "[001*]" <temp1 >temp2
tr "[2*]" "[002*]" <temp2 >temp1
tr "[3*]" "[043*]" <temp1 >temp2
tr "[4*]" "[004*]" <temp2 >temp1
tr "[5*]" "[045*]" <temp1 >temp2
tr "[6*]" "[046*]" <temp2 >temp1
tr "[7*]" "[007*]" <temp1 >temp2
tr "[8*]" "[010*]" <temp2 >temp1
tr "[9*]" "[051*]" <temp1 >temp2
tr "[a*]" "[052*]" <temp2 >temp1
tr "[b*]" "[013*]" <temp1 >temp2
tr "[c*]" "[054*]" <temp2 >temp1
tr "[d*]" "[015*]" <temp1 >temp2
tr "[e*]" "[016*]" <temp2 >temp1
tr "[f*]" "[057*]" <temp1 >$2
rm temp1 temp2
```

APPENDIX F

ATAC PROGRAM

The following programs are listings of the Main System and Receiver Control programs for the ATAC. The assembly language is to the right of the absolute listing of the first three columns.

```
LOC   OBJECT CODE      CARD IMAGE                                                                    CARDNUM
                                IDT   ATAC
0000                            DS    0100
                                ENTRY EXEC
                       WJ       EQU   0500
                       .
                       .
                       .
                       .************************************************************
                       . EXEC                                                       *
                       .                                                            *
                       . EXECUTIVE PROGRAM FOR SYSTEM.  HANDLES REQUESTS SUBMITTED*
                       . THROUGH KEYMR                                              *
                       .************************************************************
                       .
                       . *****************
                       . ESTABLISH EQUATES
                       . *****************
                       EADD     EQU   1                      ADDRESS OF INPUT BUFFER
                       EZ       EQU   2                      CONSTANT ZERO
                       EONE     EQU   3                      CONSTANT ONE
                       EL       EQU   4                      LOWER BYTE OF REQUEST
                       EXCAD    EQU   5                      ADDRESS OF REQUESTED ROUTINE
                       EU       EQU   6                      UPPER BYTE OF REQUEST
                       EC       EQU   7                      COUNT OF WORDS IN BUFFER
                       .
                       .
                       .
                       . *********
                       . EXECUTIVE
                       . *********
0100  E201 014D        EXEC     LDR   D,EADD,ETITLE          GET TITLE ADDRESS
0102  ED00 0230                 BAL   I,0,OUTPUT             OUTPUT TITLE
0104  ED00 0151                 BAL   I,RET,KEYMR            GET PROGRAM REQUEST
0106  9CF0 0136                 STRM  D,0,EXECS,16           SAVE ALL REGISTERS
                       .
                       . GET FIRST TWO LETTERS OF REQUEST
                       .
0108  4013                      LDR   IS,EONE,1              SET UP CONSTANT
0109  4002                      LDR   IS,EZ,0                SET UP CONSTANT
010A  5217                      LDR   RX,EC,EADD,EZ          GET COUNT OF WORDS IN BUFFER
010B  6011             EX1      ADD   IS,EADD,1              INCREMENT BUFFER POINTER
010C  5216                      LDR   RX,EU,EADD,EZ          GET WORD FROM BUFFER
010D  6FF7                      ADD   IS,EC,-1               DECREMENT WORD COUNT
010E  C106 0100                 BRCL  NP,EXEC                GET OUT IF NOT THERE
0110  2206                      CMP   IS,EU,020              COMPARE WITH SPACE
0111  C102 010B                 BRCL  EQ,EX1                 IF SPACE, KEEP LOOKING
0113  AE76                      SHS   LL,EU,8                POSITION UPPER BYTE
0114  5314                      LDR   RX,EL,EADD,EONE        GET NEXT WORD IN BUFFER
0115  AE74                      SHS   LL,EL,8                CLEAR UPPER BYTE
0116  AD74                      SHS   RL,EL,8                POSITION LOWER BYTE
```

```
ATAC                                                                    TIME: 15:22:49      03/21/77      PAGE     2
LOC   OBJECT CODE      CARD IMAGE                                                                        CARDNUM
0117  A446                       IOR    R,EU,EL             COMBINE FIRST TWO BYTES OF COMMAND                55
                       .                                                                                  56
0118  B106 776A                  CMP    I,EU,0776A          SEE IF REQUEST FOR WJ                         57
011A  C102 012A                  BRCL   EQ,EX2              GO CALL WJ                                    58
                       .                                                                                  59
011C  0000                       NOP                        PATCH AREA FOR ANOTHER REQUEST                60
011D  0000                       NOP                                                                      61
011E  0000                       NOP                                                                      62
011F  0000                       NOP                                                                      63
                       .                                                                                  64
                       . ECHO EXIT - INVALID REQUEST                                                      65
                       .                                                                                  66
0120  BCF0 0136                  LDRM   D,0,EXECS,16        RESTORE REGISTERS                             67
0122  ED00 0230                  BAL    I,0,OUTPUT          ECHO INPUT BUFFER                             68
0124  E101 014A                  LDR    I,1,EXCRLF          GET ADDRESS OF CR/LF BUFFER                   69
0126  ED00 0230                  BAL    I,0,OUTPUT          OUTPUT CR/LF                                  70
0128  C107 0100                  BRC    I,7,EXEC            GO TRY AGAIN                                  71
                       .                                                                                  72
                       . CALL RECEIVER CONTROL PROGRAM                                                    73
                       .                                                                                  74
012A  ED00 0500        EX2       BAL    I,RET,WJ            GO TO WJ                                      75
012C  C107 0100                  BRCL   U,EXEC                                                            76
                       .                                                                                  77
                       . PATCH AREA FOR ANOTHER REQUEST                                                   78
                       .                                                                                  79
012E  0000                       NOP                                                                      80
012F  0000                       NOP                                                                      81
0130  0000                       NOP                                                                      82
0131  0000                       NOP                                                                      83
0132  0000                       NOP                                                                      84
0133  0000                       NOP                                                                      85
0134  C107 0100                  BRCL   U,EXEC                                                            86
                       .                                                                                  87
                       .                                                                                  88
                       .                                                                                  89
                       .                                                                                  90
                       . ****                                                                             91
                       . DATA                                                                             92
                       . ****                                                                             93
                       .                                                                                  94
0136                   EXECS     DS     20                  SAVE AREA FOR REGISTERS                       95
                       .                                                                                  96
014A  0001             EXCRLF    DC     1                                                                 97
014B  0D0A                       DC     00D0A               CR/LF                                         98
014C  0000                       DC     0                                                                 99
014D  0003             ETITLE    DC     3                   COUNT                                        100
014E  4558                       DC     04558               EX                                           101
014F  4543                       DC     04543               EC                                           102
0150  0000                       DC     0                   NULL                                         103
                       .                                                                                 104
                       .                                                                                 105
                       .                                                                                 106
                       .                                                                                 107
```

```
LOC    OBJECT CODE       CARD IMAGE

                     . ************************************************************
                     . SYSTEM EQUATES                                             *
                     .                                                            *
                     . THESE ARE EQUATES THAT ARE USED FOR LINKAGE BETWEEN        *
                     . PROGRAMS OR THAT ARE USED BY AT LEAST TWO PROGRAMS IN      *
                     . THE SYSTEM                                                 *
                     . ************************************************************
                     .
                     RET       EQU    0                  RETURN REGISTER
                     .
                     .
                     . ************************************************************
                     . KEYMR                                                      *
                     .                                                            *
                     . ROUTINE TO READ DATA FROM THE KEYBOARD                     *
                     .                                                            *
                     . CALLING PROCEDURE:                                         *
                     .        BAL    I,0,KEYMR                                    *
                     .                                                            *
                     . INPUTS:                                                    *
                     .       NONE                                                 *
                     .                                                            *
                     . OUTPUTS:                                                   *
                     .     REG 1      ADDRESS OF BUFFER CONTAINING THE KEYBOARD   *
                     .                ENTRY (ONE CHARACTER PER WORD, RIGHT        *
                     .                JUSTIFIED, ASCII)                           *
                     .                THE FIRST WORD OF THE BUFFER CONTAINS THE   *
                     .                NUMBER OF CHARACTERS IN THE KEYBOARD        *
                     .                ENTRY BUFFER                                *
                     .                                                            *
                     . ROUTINES CALLED:                                           *
                     .     OUTPUT                                                 *
                     .                                                            *
                     . THIS ROUTINE PRESERVES NO REGISTERS                        *
                     . ************************************************************
                     .
                     .
                     . *****************
                     . ESTABLISH EQUATES
                     . *****************
                     .
                     KRET      EQU    0                  RETURN REGISTER
                     KBUF      EQU    1                  ADDRESS OF BUFFER HOLDING KEYBOARD
                     .                                   ENTRY
                     KPC       EQU    5                  POSITION COUNTER FOR NEXT INPUT
                     .                                   INPUT FROM KEYBOARD (CURSOR)
                     KPM       EQU    6                  MAX POSITION USED IN KEYBOARD ENTRY
                     .                                   (NUMBER OF CHARACTERS ENTERED)
                     KOR       EQU    7                  OUTPUT REGISTER
                     KIR       EQU    8                  INPUT REGISTER
                     KOUT      EQU    9                  OUTPUT DEVICE ADDRESS
                     KIN       EQU    10                 INPUT DEVICE ADDRESS
                     KV1       EQU    11                 VARIABLE 1
```

```
LOC   OBJECT CODE    CARD IMAGE                                                          CARDNUM
                     KV2       EQU    12                     VARIABLE 2
                     KV3       EQU    13                     VARIABLE 3
                     KDATA     EQU    14                     INPUT DATA FROM KEYBOARD
                     .
                     .
                     .
                     .
                     . **********************
                     . INITIALIZE AND SET UP
                     . **********************
                     .
0151  9C00 01D6      KEYMR     STR    D,KRET,RETURN          SAVE RETURN ADDRESS
0153  E101 0228      KMR1      LDR    I,KBUF,KBSTRT          GET ADDRESS OF BUFFER TO OUTPUT
0155  ED00 0230                BAL    I,KRET,OUTPUT          OUTPUT INITIAL BUFFER
0157  E10A FFBF                LDR    I,KIN,0FFBF            DEVICE ADDRESS FOR INPUT
0159  E109 BFFF                LDR    I,KOUT,0BFFF           DEVICE ADDRESS FOR OUTPUT
015B  4015                     LDR    IS,KPC,1               POSITION COUNTER = 1
015C  4016                     LDR    IS,KPM,1               MAX POSITION USED = 1
015D  E101 01D7                LDR    I,KBUF,KBUFFER         ADDRESS OF BUFFER TO REGISTER
015F  E107 8000                LDR    I,KOR,08000            RESET CODE
0161  D997                     ROUT   KOR,KOUT               RESET KEYBOARD
                     .
                     . ****************************************
                     . SET KEYBOARD ENTRY BUFFER TO ALL SPACES
                     . ****************************************
                     .
0162  450B                     LDR    IS,KV1,80              SET COUNTER TO BUFFER LENGTH
0163  E01C                     LDR    R,KV2,KBUF             GET BUFFER ADDRESS
0164  420D                     LDR    IS,KV3,020             CODE FOR SPACE
0165  1BCD           KMR2      STR    RX,KV3,KV2,KV1         STORE BLANK CODE
0166  6FFB                     ADD    IS,KV1,-1              DECREMENT COUNTER
0167  C101 0165                BRCL   GT,KMR2                DO AGAIN IF COUNTER GT 0
                     .
                     . **********************
                     . GET DATA FROM KEYBOARD
                     . **********************
                     .
0169  E107 8000      KMR3      LDR    I,KOR,08000            RESET CODE
016B  D997                     ROUT   KOR,KOUT               RESET KEYBOARD

016C  8CAE           KMR4      RIN    KDATA,KIN              GET DATA
016D  9E0E 4000                CMPL   I,KDATA,04000          DATA PRESENT ?
016F  C105 016C                BRCL   NE,KMR4                NO DATA, WAIT

0171  E107 8000      KMR5      LDR    I,KOR,08000            RESET CODE
0173  D997                     ROUT   KOR,KOUT               RESET KEYBOARD
0174  8CA8                     RIN    KIR,KIN                GET STATUS
0175  9E08 2000                CMPL   I,KIR,02000            DATA STILL PRESENT ?
0177  C102 0171                BRCL   EQ,KMR5                KEEP TRYING TO CLEAR
                     .
                     . *************
                     . DATA OBTAINED
                     . *************
```

```
LOC   OBJECT CODE       CARD IMAGE                                                      CARDNUM

                      .
0179  A10E 007F                 AND   I,KDATA,0007F        SAVE DATA ONLY
                      .
017B  208E                      CMP   IS,KDATA,008         COMPARE WITH BACKSPACE
017C  C105 0184                 BRCL  NE,KMR6              NOT BACKSPACE
017E  6FF5                      ADD   IS,KPC,-1            DECREMENT POINTER
017F  C105 0169                 BRCL  NZ,KMR3              LOOK FOR DATA IF PC NOT ZERO
0181  4015                      LDR   IS,KPC,1              SET PC = 1
0182  C107 0169                 BRCL  U,KMR3               GET MORE DATA
                      .
0184  21CE            KMR6      CMP   IS,KDATA,01C         COMPARE WITH FORWARD SPACE
0185  C105 0190                 BRCL  NE,KMR8              NOT FORWARD SPACE
0187  6015            KMR7      ADD   IS,KPC,1             INCREMENT POSITION COUNTER
0188  B105 0050                 CMP   I,KPC,80             COMPARE WITH MAX VALUE
018A  C106 0169                 BRCL  LE,KMR3              LESS OR EQUAL MAX, GET MORE DATA
018C  E105 0050                 LDR   I,KPC,80             SET POSITION COUNTER TO 80
018E  C107 01B9                 BRCL  U,KMR11              GET OUT OF ROUTINE
                      .
0190  20DE            KMR8      CMP   IS,KDATA,00D         COMPARE WITH CARRIAGE RETURN
0191  C102 01B9                 BRCL  EQ,KMR11             CR, GET OUT
                      .
0193  22EE                      CMP   IS,KDATA,02E         COMPARE WITH DECIMAL POINT
0194  C102 01B1                 BRCL  EQ,KMR10             DECIMAL POINT, PUT IN BUFFER
                      .
0196  220E                      CMP   IS,KDATA,020         COMPARE WITH SPACE
0197  C102 01B1                 BRCL  EQ,KMR10             SPACE, PUT IN BUFFER
                      .
0199  230E                      CMP   IS,KDATA,030         COMPARE WITH 0
019A  C104 01AB                 BRCL  LT,KMR9              ILLEGAL CHARACTER
                      .
019C  239E                      CMP   IS,KDATA,039         COMPARE WITH 9
019D  C106 01B1                 BRCL  LE,KMR10             NUMERIC, PUT IN BUFFER
                      .
019F  241E                      CMP   IS,KDATA,041         COMPARE WITH UPPER CASE A
01A0  C104 01AB                 BRCL  LT,KMR9              ILLEGAL CHARACTER
                      .
01A2  25AE                      CMP   IS,KDATA,05A         COMPARE WITH UPPER CASE Z
01A3  C106 01B1                 BRCL  LE,KMR10             UPPER CASE ALPHA, PUT IN BUFFER
                      .
01A5  261E                      CMP   IS,KDATA,061         COMPARE WITH LOWER CASE A
01A6  C104 01AB                 BRCL  LT,KMR9              ILLEGAL CHARACTER
                      .
01A8  27AE                      CMP   IS,KDATA,07A         COMPARE WITH LOWER CASE Z
01A9  C106 01B1                 BRCL  LE,KMR10             LOWER CASE ALPHA, PUT IN BUFFER
                      .
                      . *************
                      . ILLEGAL ENTRY
                      . *************
01AB  E101 022C       KMR9      LDR   I,KBUF,KBILL         GET ADDRESS OF ILLEGAL BUFFER
01AD  ED00 0230                 BAL   I,KRET,OUTPUT        OUTPUT BUFFER
01AF  C107 0153                 BRCL  U,KMR1               START OVER
                      .
```

```
LOC   OBJECT CODE      CARD IMAGE                                                                         CARDNUM

                     . ***************************
                     . VALID ENTRY - PUT IN BUFFER
                     . ***************************
                     .
01B1  9B5E 01D7      KMR10      STR    DX,KDATA,KBUFFER,KPC  PUT DATA IN BUFFER
01B3  B056                      CMP    R,KPM,KPC             COMPARE MAX USED WITH LAST POSITIO
01B4  C103 0187                 BRCL   GE,KMR7               GO INCREMENT POSITION COUNTER
01B6  E056                      LDR    R,KPM,KPC             PM = PC
01B7  C107 0187                 BRCL   U,KMR7                KEEP GETTING DATA
                     .
                     . ****
                     . EXIT
                     . ****
                     .
01B9  9C06 01D7      KMR11      STR    D,KPM,KBUFFER         PUT COUNT IN BUFFER
                     .---------------------------------------------------------------------------
                     . THIS IS THE SEQUENCE FOR CALLING 'CORE' (UTILITY TO DISPLAY AND
                     . CHANGE CORE INTERACTIVELY). ALL CODE BETWEEN DOTTED LINES MAY BE
                     . REMOVED WHEN A CALL TO THAT PROGRAM IS NO LONGER DESIRED.
01EB  E01B                      LDR    R,KV1,KBUF
01BC  4005                      LDR    IS,KPC,0
01BD  601B           KMR30      ADD    IS,KV1,1
01BE  55BC                      LDR    RX,KV2,KV1,KPC
01BF  6FF6                      ADD    IS,KPM,-1
01C0  C106 01D3                 BRCL   NP,KMR12
01C2  220C                      CMP    IS,KV2,020
01C3  C102 01BD                 BRCL   EQ,KMR30
01C5  601B                      ADD    IS,KV1,1
01C6  AE7C                      SHS    LL,KV2,8
01C7  55BD                      LDR    RX,KV3,KV1,KPC
01C8  AE7D                      SHS    LL,KV3,8
01C9  AD7D                      SHS    RL,KV3,8
01CA  80DC                      ADD    R,KV2,KV3
01CB  B10C 636F                 CMP    I,KV2,0636F
01CD  C105 01D3                 BRCL   NE,KMR12
01CF  E202 01D6                 LDR    D,2,RETURN            GET ADDRESS OF CALLING ROUTINE
01D1  C107 02F8                 BRC    I,7,CORE              GO PROCESS CORE REQUEST
                     .---------------------------------------------------------------------------
01D3  E200 01D6      KMR12      LDR    D,KRET,RETURN         RESTORE RETURN ADDRESS
01D5  BF07                      BRC    R,7,KRET              RETURN
                     .
                     .
                     .
                     .
                     . ****
                     . DATA
                     . ****
                     .
01D6                 RETURN     DS     1                     RETURN ADDRESS STORAGE
                     .
                     . *********************
```

```
LOC   OBJECT CODE     CARD IMAGE                                                              CARDNUM
                    . KEYBOARD ENTRY BUFFER
                    . *********************
                    .
01D7  0050          KBUFFER  DC    80                    COUNT
01D8                         DS    80                    RESERVE
                    .
                    . *******************
                    . START SYMBOL BUFFER
                    . *******************
                    .
0228  0003          KBSTRT   DC    3                     COUNT
0229  0D0A                   DC    00D0A                 CR/LF
022A  002B                   DC    002B                  +
022B  0000                   DC    00000                 NULL
                    .
                    . ************************
                    . ILLEGAL CHARACTER BUFFER
                    . ************************
                    .
022C  0003          KBILL    DC    3                     COUNT
022D  0A07                   DC    00A07                 CR,BELL
022E  0707                   DC    00707                 BELL,BELL
022F  0000                   DC    00000                 NULL
                    .
                    .
                    .
                    . ***********************************************************
                    . OUTPUT                                                    *
                    .                                                           *
                    . ROUTINE TO OUTPUT TO THE TTY/CRT                          *
                    .                                                           *
                    . CALLING PROCEDURE:                                        *
                    .        BAL   I,0,OUTPUT                                   *
                    .                                                           *
                    . INPUTS:                                                   *
                    .     REG 1      ADDRESS OF BUFFER TO BE OUTPUT             *
                    .                                                           *
                    . THE BUFFER MUST BE SET UP IN THE FOLLOWING MANNER:        *
                    .     WORD 1     N = NUMBER OF WORDS IN BUFFER TO BE OUTPUT *
                    .     WORDS 2-N ASCII DATA TO BE OUTPUT, TWO ASCII          *
                    .                CHARACTERS PER WORD                        *
                    .                                                           *
                    . OUTPUTS:                                                  *
                    .     NONE                                                  *
                    .                                                           *
                    . ROUTINES CALLED:                                          *
                    .     NONE                                                  *
                    .                                                           *
                    . THIS ROUTINE PRESERVES NO REGISTERS                       *
                    . ***********************************************************
                    .
                    .
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                CARDNUM
                      . *****************
                      . ESTABLISH EQUATES
                      . *****************
                      .
                      BUFAD     EQU    1                    ADDRESS OF BUFFER TO OUTPUT
                      BO        EQU    5                    OUTPUT BUFFER ADDRESS
                      VIN       EQU    6                    INPUT DEVICE ADDRESS
                      VOUT      EQU    7                    OUTPUT DEVICE ADDRESS
                      VL        EQU    8                    INPUT BUFFER LOWER BYTE
                      VU        EQU    9                    INPUT BUFFER UPPER BYTE
                      WO        EQU    10                   NUMBER OF WORDS TO OUTPUT
                      WI        EQU    11                   NUMBER OF WORDS TO INPUT
                      VIU       EQU    12                   UPPER BYTE INDEX
                      VIL       EQU    13                   LOWER BYTE INDEX
                      STAT      EQU    14                   STATUS
                      WOUT      EQU    15                   WORD TO OUTPUT TO TTY
                      .
                      .
                      .
                      .
                      . ********************************
                      . INITIALIZE AND SET UP CONSTANTS
                      . ********************************
                      .
0230  400C            OUTPUT    LDR    IS,VIU,0             INDEX FOR STORING UPPER BYTE
0231  401D                      LDR    IS,VIL,1             INDEX FOR STORING LOWER BYTE
0232  E106 FFBF                 LDR    I,VIN,0FFBF          INPUT DEVICE ADDRESS
0234  E107 BFFF                 LDR    I,VOUT,0BFFF         OUTPUT DEVICE ADDRESS
0236  51CB                      LDR    RX,WI,VIU,BUFAD      GET INPUT WORD COUNT
0237  9C0C 026A       OUT5      STR    D,VIU,COUNT          INITIALIZE COUNT
0239  200B                      CMP    IS,WI,0              COMPARE WORD COUNT WITH ZERO
023A  C106 0269                 BRCL   LE,OUT4              GET OUT IF COUNT LESS THAN ZERO
023C  228B                      CMP    IS,WI,40             COMPARE WITH MAX VALUE
023D  C106 0242                 BRCL   LE,OUT3              IF IN LIMIT KEEP GOING
023F  9C0B 026A                 STR    D,WI,COUNT           SAVE ORIGINAL COUNT
0241  428B                      LDR    IS,WI,40             ONLY OUTPUT 40 WORDS
0242  E0BA            OUT3      LDR    R,WO,WI              PUT IN OUTPUT WORD COUNT
0243  AE0A                      SHS    LL,WO,1              DOUBLE FOR OUTPUT WORD COUNT
0244  E105 026B                 LDR    I,BO,BUFOUT          GET OUTPUT BUFFER ADDRESS
                      .
                      . ***********************************************
                      . TRANSFER INPUT BYTE BUFFER TO OUTPUT WORD BUFFER
                      . ***********************************************
                      .
0246  6011            OUT1      ADD    IS,BUFAD,1           INCREMENT INPUT POINTER TO NEXT ENTR
0247  51C9                      LDR    RX,VU,VIU,BUFAD      GET INPUT WORD IN UPPER BYTE REGISTE
0248  E098                      LDR    R,VL,VU              PUT IN LOWER BYTE REGISTER ALSO
0249  AE78                      SHS    LL,VL,8              CLEAR UPPER BYTE
024A  AD78                      SHS    RL,VL,8              RIGHT JUSTIFY LOWER BYTE
024B  AD79                      SHS    RL,VU,8              RIGHT JUSTIFY UPPER BYTE
024C  15C9                      STR    RX,VU,VIU,BO         STORE UPPER BYTE AS FULL WORD
                      .                                     IN THE OUTPUT BUFFER
024D  15D8                      STR    RX,VL,VIL,BO         STORE LOWER BYTE AS FULL WORD
```

```
LOC   OBJECT CODE    CARD IMAGE                                       CARDNUM
                     .                              IN THE OUTPUT BUFFER
024E  6025                   ADD    IS,BO,2         INCREMENT OUTPUT BUFFER POINTER
024F  6FFB                   ADD    IS,WI,-1        DECREMENT NUMBER OF WORDS TO INPUT
0250  C101 0246              BRCL   GT,OUT1         DO AGAIN IF NOT FINISHED
                     .
                     . ******************
                     . OUTPUT WORD BUFFER
                     . ******************
                     .
0252  E105 026B              LDR    I,BO,BUFOUT     GET ADDRESS OF OUTPUT BUFFER
0254  8C6E           OUT2    RIN    STAT,VIN        GET STATUS
0255  9E0E 1000              CMPL   I,STAT,01000    COMPARE STATUS
0257  C105 0254              BRCL   NE,OUT2         WAIT IF NOT READY
0259  B75F 0000              LLC    DX,WOUT,0,BO    GET CHARACTER TO OUTPUT
025B  A10F 01FF              AND    I,WOUT,001FF    CLEAR ALL BUT OUTPUT DATA
025D  D97F                   ROUT   WOUT,VOUT       OUTPUT A CHARACTER
025E  6015                   ADD    IS,BO,1         INCREMENT BUFFER POINTER
025F  6FFA                   ADD    IS,WO,-1        DECREMENT WORD COUNTER
0260  C101 0254              BRCL   GT,OUT2         GO OUTPUT ANOTHER CHARACTER
                     .
                     . ****
                     . EXIT
                     . ****
                     .
0262  F20B 026A              LDR    D,WI,COUNT      GET EXCESS COUNT
0264  C102 0269              BRCL   Z,OUT4          GET OUT IF ZERO
0266  6D8B                   ADD    IS,WI,-40       DECREMENT BY 40
0267  C107 0237              BRCL   U,OUT5          DO AGAIN
C269  BF07           OUT4    BRC    R,7,RET
                     .
                     . ****
                     . DATA
                     . ****
                     .
026A                 COUNT   DS     1               SAVE LOCATION FOR EXCESS COUNT
                     .
026B                 BUFOUT  DS     80              OUTPUT BUFFER
                     .
                     .
                     .
                     . ***********************************************************
                     . HEXA                                                      *
                     .                                                           *
                     . ROUTINE TO CONVERT HEX TO ASCII                           *
                     .                                                           *
                     . CALLING PROCEDURE:                                        *
                             BAL    I,0,HEXA                                     *
                     .                                                           *
                     . INPUTS:                                                   *
                           REG 1      HEX VALUE TO BE CONVERTED (INTEGER)        *
                     .                                                           *
                     . OUTPUTS:                                                  **
```

```
LOC   OBJECT CODE      CARD IMAGE

                       .      REG 2      MOST SIGNIFICANT TWO DIGITS IN ASCII        *
                       .      REG 3      LEAST SIGNIFICANT TWO DIGITS IN ASCII       *
                       .      LETTERS ARE OUTPUT IN UPPER CASE                       *
                       .                                                             *
                       .  ROUTINES CALLED:                                           *
                       .      NONE                                                   *
                       .                                                             *
                       .  THIS ROUTINE DOES NOT DISTURB REGISTERS 5 THROUGH 15       *
                       .  ***********************************************************
                       .
                       .
                       .  *****************
                       .  ESTABLISH EQUATES
                       .  *****************
                       .
                       HIN       EQU   1                      HEX VALUE INPUT
                       MSD       EQU   2                      MOST SIGNIFICANT DIGITS TO OUTPUT
                       LSD       EQU   3                      LEAST SIGNIFICANT DIGITS TO OUTPUT
                       V1        EQU   4                      VARIABLE
                       .
                       .
                       .
                       .
                       .  ****************
                       .  CONVERT TO ASCII
                       .  ****************
                       .
02BB  9C00 02E1        HEXA      STR   D,RET,HEXRTN           SAVE RETURN REGISTER
02BD  E014                       LDR   R,V1,HIN               GET HEX INPUT VALUE
02BE  ADB4                       SHS   RL,V1,12               RIGHT JUSTIFY FIRST DIGIT
02BF  ED00 02DB                  BAL   I,RET,HEXA1            CONVERT FIRST DIGIT
02C1  AE74                       SHS   LL,V1,8                POSITION DIGIT
02C2  E042                       LDR   R,MSD,V1               PUT IN OUTPUT REGISTER
02C3  E014                       LDR   R,V1,HIN               GET HEX INPUT VALUE
02C4  AD74                       SHS   RL,V1,8                RIGHT JUSTIFY SECOND DIGIT
02C5  A104 000F                  AND   I,V1,0000F             CLEAR ALL BUT SECOND DIGIT
02C7  ED00 02DB                  BAL   I,RET,HEXA1            CONVERT SECOND DIGIT
02C9  8042                       ADD   R,MSD,V1               PUT IN OUTPUT REGISTER
02CA  E014                       LDR   R,V1,HIN               GET HEX INPUT VALUE
02CB  A104 00F0                  AND   I,V1,000F0             CLEAR ALL BUT THIRD DIGIT
02CD  AD34                       SHS   RL,V1,4                RIGHT JUSTIFY THIRD DIGIT
02CE  ED00 02DB                  BAL   I,RET,HEXA1            CONVERT THIRD DIGIT
02D0  AE74                       SHS   LL,V1,8                POSITION DIGIT
02D1  E043                       LDR   R,LSD,V1               PUT IN OUTPUT REGISTER
02D2  E014                       LDR   R,V1,HIN               GET HEX INPUT VALUE
02D3  A104 000F                  AND   I,V1,0F                CLEAR ALL BUT FOURTH DIGIT
02D5  ED00 02DB                  BAL   I,RET,HEXA1            CONVERT FOURTH DIGIT
02D7  8043                       ADD   R,LSD,V1               PUT IN OUTPUT REGISTER
                       .  ****
                       .  EXIT
                       .  ****
                       .
```

```
LOC   OBJECT CODE     CARD IMAGE                                                          CARDNUM

02D8  E200 02E1              LDR   D,RET,HEXRTN            GET RETURN ADDRESS
02DA  BF07                   BRC   R,7,RET                 RETURN
                     .
                     . *****************
                     . CONVERT ONE DIGIT
                     . *****************
                     .
02DB  20A4           HEXA1   CMP   IS,V1,00A               COMPARE WITH HEX 'A'
02DC  C104 02DF              BRCL  LT,HEXA2                BRANCH IF LESS
02DE  6074                   ADD   IS,V1,7                 ADD 7 TO VALUE
02DF  6304           HEXA2   ADD   IS,V1,030               ADD HEX '30'
02E0  BF07                   BRC   R,7,RET                 GO BACK TO WHERE CALLED FROM
                     .
                     . ****
                     . DATA
                     . ****
                     .
02E1                 HEXRTN  DS    1                       SAVE LOCATION FOR RETURN ADDRESS
                     .
                     .
                     .
                     .****************************************************************
                     . AHEX                                                           *
                     .                                                                *
                     . ROUTINE TO CONVERT FOUR (4) OR LESS DIGITS IN ASCII            *
                     . CODE TO A TRUE HEX VALUE FOR THE MACHINE.  SIGN OF THE         *
                     . VALUE MUST BE HANDLED BY THE CALLING ROUTINE.                  *
                     .                                                                *
                     . CALLING PROCEDURE:                                             *
                     .            BAL    I,0,AHEX                                     *
                     .                                                                *
                     . INPUTS:                                                        *
                     .       REG 1      ADDRESS OF FIRST CONSECUTIVE LOCATION IN      *
                     .                  CORE WHERE THE ASCII CHARACTERS ARE LOCATED*
                     .                  (ONE CHARACTER PER CORE LOCATION)             *
                     .                                                                *
                     . OUTPUT:                                                        *
                     .       REG 2      HEX VALUE                                     *
                     .                                                                *
                     . ROUTINES CALLED:                                               *
                     .       NONE                                                     *
                     .                                                                *
                     . REGISTERS 8 THROUGH 16 ARE PRESERVED                           *
                     .****************************************************************
                     .
                     . *****************
                     . ESTABLISH EQUATES
                     . *****************
                     .
                     AHADD   EQU   1                       ADDRESS OF ASCII CHARACTERS
                     AHOUT   EQU   2                       OUTPUT HEX VALUE
                     AHV1    EQU   5                       VARIABLE 1
```

```
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LOC   OBJECT CODE      CARD IMAGE                                                                           CARDNUM
                       AHV2     EQU   6                       VARIABLE 2
                       AHZ      EQU   7                       ZERO
                       .
                       .
                       .
                       .
                       . ********************
                       . CONVERT ASCII TO HEX
                       . ********************
                       .
02E2  4002             AHEX     LDR   IS,AHOUT,0              CLEAR REGISTER
02E3  4045                      LDR   IS,AHV1,4               SET UP COUNTER
02E4  4007                      LDR   IS,AHZ,0                SET UP ZERO REGISTER
02E5  5176             AH1      LDR   RX,AHV2,AHZ,AHADD       GET ASCII CHARACTER
02E6  2206                      CMP   IS,AHV2,020             COMPARE WITH SPACE
02E7  C102  02F7                BRCL  EQ,AH3                  DON'T TRANSLATE SPACES
02E9  AE32                      SHS   LL,AHOUT,4              MOVE DIGIT OVER
02EA  2406                      CMP   IS,AHV2,040             COMPARE WITH MIN LETTER
02EB  C104  02EE                BRCL  LT,AH2                  SKIP IF NUMERIC
02ED  6096                      ADD   IS,AHV2,9               INCREMENT ALPHA
02EE  A106  000F       AH2      AND   I,AHV2,0000F            CLEAR ALL BUT DIGIT
02F0  8062                      ADD   R,AHOUT,AHV2            PUT IN OUTPUT REGISTER
02F1  6FF5                      ADD   IS,AHV1,-1              DECREMENT COUNTER
02F2  C102  02F7                BRCL  Z,AH3                   DONE
02F4  6011                      ADD   IS,AHADD,1              INCREMENT CHARACTER ADDRESS
02F5  C107  02E5                BRCL  U,AH1                   KEEP GOING
02F7  BF07             AH3      BRC   R,7,RET                 GET OUT
                       .
                       .
                       .
                       .*************************************************************
                       . CORE                                                        *
                       .                                                             *
                       . ROUTINE TO CONTROL CORE INTERACTIVELY FROM THE KEYBOARD.    *
                       .                                                             *
                       .                                                             *
                       . *****WARNING*****                                           *
                       . THIS ROUTINE SHOULD ONLY BE CALLED BY 'KEYMR'. THERE ARE    *
                       . SPECIAL CONSIDERATIONS IN CALLING WHICH ARE TAKEN INTO      *
                       . ACCOUNT BY KEYMR. (TAKE SPECIAL NOTE OF REGISTER 2 WHEN     *
                       . 'CORE' IS CALLED AND THE WAY 'CORE' EXITS THROUGH 'KEYMR'   *
                       .                                                             *
                       .                                                             *
                       . MAY BE INITIATED BY THE OPERATOR AT ANY TIME WHEN THE       *
                       . KEYBOARD IS ACCEPTING DATA BY TYPING 'CORE'.    ONCE        *
                       . ENTERED, IT REMAINS IN CONTROL UNTIL RELEASED BY THE        *
                       . TYPED COMMAND 'DONE'. THE COMMANDS AND FUNCTIONS ARE        *
                       . AS LISTED:                                                  *
                       .                                                             *
                       .      COMMAND                  FUNCTION                      *
                       .                                                             *
                       .      DUMP 'ADD'               PRINTS 10 LINES OF 8 VALUES   *
```

```
LOC   OBJECT CODE      CARD IMAGE                                                                    CARDNUM
                     .                             OF CORE STARTING WITH THE      *
                     .                             ADDRESS SPECIFIED . 'ADD'      *
                     .                             MUST BE HEXIDECIMAL - ALPHA    *
                     .                             CHARACTERS IN UPPER CASE.      *
                     .                             'DUMP' MUST BE TYPED IN LOWER  *
                     .                             CASE LETTERS                   *
                     .                                                            *
                     .   CHANGE 'ADD' 'VALUE'      CHANGES THE CONTENTS OF THE    *
                     .                             CORE LOCATION WHOSE ADDRESS    *
                     .                             IS SPECIFIED TO THE VALUE      *
                     .                             SPECIFIED                      *
                     .                                                            *
                     .   DISPLAY 'ADD'             DISPLAYS THE CONTENTS OF THE   *
                     .                             CORE LOCATION IN 'ADD'         *
                     .                                                            *
                     .   CS 'ADD'                  INITIATES THE CHANGING OF CORE*
                     .                             SEQUENTIALLY STARTING WITH THE*
                     .                             SPECIFIED ADDRESS. AFTER THIS *
                     .                             COMMAND, THE FIRST FOUR CHARA-*
                     .                             CTERS TYPED ARE PLACED IN CORE*
                     .                             AND THE ADDRESS INCREMENTED BY*
                     .                             ONE.  THE CHANGE IS TERMINATED*
                     .                             BY TYPING 'DONE'.(THIS TYPING *
                     .                             OF 'DONE' DOES NOT CAUSE THE  *
                     .                             CORE PROGRAM TO BE EXITED)    *
                     .                                                            *
                     . CALLING PROCEDURE:                                         *
                     .        BAL    I,0,CORE                                     *
                     .                                                            *
                     . INPUTS:                                                    *
                     .     NONE                                                   *
                     .                                                            *
                     . OUTPUTS:                                                   *
                     .     NONE                                                   *
                     .                                                            *
                     . ROUTINES CALLED:                                           *
                     .     KEYMR                                                  *
                     .     OUTPUT                                                 *
                     .     HEXA                                                   *
                     .     AHEX                                                   *
                     .                                                            *
                     . THIS ROUTINE PRESERVES NO REGISTERS                        *
                     .*************************************************************
                     .
                     . *****************
                     . ESTABLISH EQUATES
                     . *****************
                     .
                     CADD      EQU    1                 ADDRESS OF BUFFER RETURNED
                     CHV       EQU    1                 HEX VALUE TO INPUT TO HEXA
                     CA1       EQU    2                 ASCII MSD RETURNED BY HEXA
                     CA2       EQU    3                 ASCII LSD RETURNED BY HEXA
```

```
LOC   OBJECT CODE    CARD IMAGE                                                                    CARDNUM
                     CV3      EQU   5                      VARIABLE 3                                  691
                     CMAX     EQU   6                      MAX NO. CHARACTERS INPUT BY KEYMR           692
                     CINDX    EQU   7                      PATH FLAG                                   693
                     CFLG     EQU   8                      BLANK FLAG                                  694
                     CF2      EQU   9                      FIELD2                                      695
                     CZERO    EQU   10                     CONSTANT 0                                  696
                     CSPACE   EQU   11                     ASCII CODE FOR SPACE                        697
                     CV1      EQU   12                     VARIABLE 1                                  698
                     CV2      EQU   13                     VARIABLE 2                                  699
                     CMD      EQU   14                     COMMAND                                     700
                     CF1      EQU   15                     FIELD 1                                     701
                     .                                                                                 702
                     .                                                                                 703
                     .                                                                                 704
                     .                                                                                 705
                     . ******                                                                          706
                     . SET UP                                                                          707
                     . ******                                                                          708
                     .                                                                                 709
02F8  9C02 03D3      CORE     STR   D,2,CSAVE              SAVE REGISTER 2                             710
02FA  400C                    LDR   IS,CV1,0               GET A ZERO                                  711
02FB  9C0C 0412               STR   D,CV1,CSFLG            INITIALIZE SEQUENTIAL CHANGE FLAG           712
02FD  E101 0405      C1       LDR   I,CADD,CTITLE          GET BUFFER ADDRESS FOR TITLE                713
02FF  ED00 0230               BAL   I,RET,OUTPUT           OUTPUT TITLE                                714
0301  ED00 0151               BAL   I,RET,KEYMR            GET KEYBOARD COMMAND                        715
0303  E10B 2020               LDR   I,CSPACE,02020         SET UP SPACE CODE                           716
0305  400A                    LDR   IS,CZERO,0             SET UP ZERO CONSTANT                        717
0306  400E                    LDR   IS,CMD,0               ZERO COMMAND REGISTER                       718
0307  400F                    LDR   IS,CF1,0               ZERO FIELD 1                                719
0308  4009                    LDR   IS,CF2,0               ZERO FIELD 2                                720
0309  4008                    LDR   IS,CFLG,0              ZERO FLAG                                   721
030A  4007                    LDR   IS,CINDX,0             ZERO PATH FLAG                              722
                     .                                                                                 723
                     . *****************                                                               724
                     . TRANSLATE COMMAND                                                               725
                     . *****************                                                               726
                     .                                                                                 727
030B  51A6                    LDR   RX,CMAX,CZERO,CADD     GET NO. OF ENTRIES IN BUFFER                728
030C  4008           C2       LDR   IS,CFLG,0              SET FLAG FOR READY                          729
030D  6011           C3       ADD   IS,CADD,1              INCREMENT BUFFER ADDRESS                    730
030E  6FF6                    ADD   IS,CMAX,-1             DECREMENT CHARACTER COUNTER                 731
030F  C106 0327               BRCL  NP,C6A                 DONE                                        732
0311  51AC                    LDR   RX,CV1,CZERO,CADD      GET A CHARACTER FROM THE BUFFER             733
0312  220C                    CMP   IS,CV1,020             COMPARE WITH SPACE                          734
0313  C102 030C               BRCL  EQ,C2                  KEEP GOING IF SPACE                         735
0315  2008                    CMP   IS,CFLG,0              SEE IF IN MIDDLE OF ENTRY                   736
0316  C105 030D               BRCL  NE,C3                  IN ENTRY, KEEP LOOKING                      737
                     .                                                                                 738
0318  E370 031B               LDR   DX,RET,CFLD,CINDX      GET PROCESSING ADDRESS                      739
031A  BF07                    BRC   R,7,RET                PROCESS ACCORDING TO FIELD FOUND            740
                     .                                                                                 741
                     . BRANCH TABLE                                                                    742
                     .                                                                                 743
```

```
LOC   OBJECT CODE     CARD IMAGE

031B  031E            CFLD     DC     C4                     COMMAND FIELD
031C  0323                     DC     C5                     FIELD 1
031D  0326                     DC     C6                     FIELD 2
                      .
                      .
031E  E01E            C4       LDR    R,CMD,CADD             ADDRESS OF COMMAND
031F  6017            C7       ADD    IS,CINDX,1             INCREMENT PATH INDEX
0320  4FF8                     LDR    IS,CFLG,-1             SET FLAG FOR IN ENTRY
0321  C107 030D                BRCL   U,C3                   KEEP GOING
0323  E01F            C5       LDR    R,CF1,CADD             ADDRESS OF FIELD 1
0324  C107 031F                BRCL   U,C7                   KEEP GOING
0326  E019            C6       LDR    R,CF2,CADD             ADDRESS OF FIELD 2
                      .
                      .
0327  200F            C6A      CMP    IS,CF1,0               SEE IF FIELD 1 IS PRESENT
0328  C102 0335                BRCL   EQ,C8                  GO PROCESS COMMAND ONLY
                      .
                      . CONVERT FIELD 1 TO HEX
                      .
032A  E0F1                     LDR    R,CADD,CF1             PUT ADDRESS IN REGISTER
032B  ED00 02E2                BAL    I,RET,AHEX             CONVERT VALUE
032D  E02F                     LDR    R,CF1,CA1              PUT HEX VALUE IN FIELD
                      .
                      .
032E  2009                     CMP    IS,CF2,0               SEE IF FIELD 2 IS PRESENT
032F  C102 0335                BRCL   EQ,C8                  GO PROCESS COMMAND
                      .
                      . CONVERT FIELD 2 TO HEX
                      .
0331  E091                     LDR    R,CADD,CF2             PUT ADDRESS IN REGISTER
0332  ED00 02E2                BAL    I,RET,AHEX             CONVERT VALUE
0334  E029                     LDR    R,CF2,CA1              PUT HEX VALUE IN FIELD
                      .
                      .
                      . BRANCH TO PROCESS ON COMMAND
                      .
0335  5EAC            C8       LDR    RX,CV1,CZERO,CMD       GET FIRST CHARACTER OF COMMAND
0336  601E                     ADD    IS,CMD,1               INCREMENT ADDRESS
0337  5EAD                     LDR    RX,CV2,CZERO,CMD       GET SECOND CHARACTER OF COMMAND
0338  A10D 00FF                AND    I,CV2,000FF            CLEAR UPPER BITS
033A  AE7C                     SHS    LL,CV1,8               LEFT JUSTIFY 1ST CHARACTER
033B  80DC                     ADD    R,CV1,CV2              PUT 1ST 2 CHARACTERS IN ONE WORD
                      .
033C  B10C 646F                CMP    I,CV1,0646F            COMPARE WITH 'DO'
033E  C102 0352                BRCL   EQ,C9                  GO PROCESS DONE
                      .
0340  B10C 6475                CMP    I,CV1,06475            COMPARE WITH 'DU'
0342  C102 0356                BRCL   EQ,C10                 GO PROCESS DUMP
                      .
0344  B10C 6469                CMP    I,CV1,06469            COMPARE WITH 'DI'
0346  C102 0383                BRCL   EQ,C11                 GO PROCESS DISPLAY
                      .
0348  B10C 6368                CMP    I,CV1,06368            COMPARE WITH 'CH'
```

```
LOC   OBJECT CODE      CARD IMAGE

034A  C102 039C                 BRCL  EQ,C12               GO PROCESS 'CHANGE'
                      .
034C  B10C 6373                 CMP   I,CV1,06373          COMPARE WITH 'CS'
034E  C102 03A0                 BRCL  EQ,C20               GO PROCESS CHANGE SEQUENTIAL
                      .
0350  C107 02FD                 BRCL  U,C1                 INVALID COMMAND, GO TRY AGAIN
                      .
                      .
                      .
                      .
                      . ****
                      . DONE
                      . ****
0352  E200 03D3       C9        LDR   D,0,CSAVE            GET ADDRESS OF CALLING ROUTINE
0354  C107 0151                 BRC   I,7,KEYMR            EXIT THROUGH KEYMR
                      .
                      .
                      .
                      .
                      . ****
                      . DUMP
                      . ****
                      .
0356  A10F FFF8       C10       AND   I,CF1,0FFF8          CLEAR LAST THREE BITS
0358  E0F5                      LDR   R,CV3,CF1            SET UP ADDRESS TO DUMP
0359  40A7                      LDR   IS,CINDX,10          SET UP LINE COUNTER
                      .
                      . OUTPUT LINE OF CORE WITH ADDRESS OF FIRST VALUE
                      .
035A  E10C 03D5       C13       LDR   I,CV1,CBUFF          SET UP OUTPUT BUFFER ADDRESS
035C  E0AD                      LDR   R,CV2,CZERO          SET UP ROW COUNTER
035D  E051                      LDR   R,CADD,CV3           SET UP INPUT FOR HEXA
035E  ED00 02BB                 BAL   I,RET,HEXA           CONVERT ADDRESS TO ASCII
0360  1AC2                      STR   RX,CA1,CV1,CZERO     PUT MSD OF ADD IN OUTPUT BUFFER
0361  601C                      ADD   IS,CV1,1             INCREMENT BUFFER ADDRESS
0362  1AC3                      STR   RX,CA2,CV1,CZERO     PUT LSD OF ADD IN OUTPUT BUFFER
0363  601C                      ADD   IS,CV1,1             INCREMENT BUFFER ADDRESS
0364  1ACB                      STR   RX,CSPACE,CV1,CZERO    PUT IN SPACES
0365  601C            C14       ADD   IS,CV1,1             INCREMENT BUFFER ADDRESS
0366  1ACB                      STR   RX,CSPACE,CV1,CZERO    PUT IN SPACES
0367  601C                      ADD   IS,CV1,1             INCREMENT BUFFER ADDRESS
0368  5A51                      LDR   RX,CADD,CV3,CZERO    GET VALUE TO CONVERT
0369  6015                      ADD   IS,CV3,1             INCREMENT ADD OF VALUE TO OUTPUT
036A  ED00 02BB                 BAL   I,RET,HEXA           CONVERT VALUE
036C  1AC2                      STR   RX,CA1,CV1,CZERO     PUT MSD OF VALUE IN OUTPUT BUFFER
036D  601C                      ADD   IS,CV1,1             INCREMENT BUFFER ADDRESS
036E  1AC3                      STR   RX,CA2,CV1,CZERO     PUT LSD OF VALUE IN OUTPUT BUFFER
036F  601D                      ADD   IS,CV2,1             INCREMENT ROW COUNTER
0370  208D                      CMP   IS,CV2,8             COMPARE WITH LAST VALUE
0371  C102 0375                 BRCL  EQ,C15               BRANCH IF EQUAL
0373  C107 0365                 BRCL  U,C14                GO DO ANOTHER VALUE
0375  E101 03D5       C15       LDR   I,CADD,CBUFF         GET BUFFER POINTER
```

```
LOC   OBJECT CODE      CARD IMAGE                                                                  CARDNUM
0377  6FF1                       ADD   IS,CADD,-1          DECREMENT BY ONE TO GET COUNT                850
0378  9CF0 03F1                  STRM  D,0,CS1,16          SAVE REGISTERS                               851
037A  ED00 0230                  BAL   I,RET,OUTPUT        OUTPUT ONE LINE                              852
037C  BCF0 03F1                  LDRM  D,0,CS1,16          RESTORE REGISTERS                            853
037E  6FF7                       ADD   IS,CINDX,-1         DECREMENT LINE COUNTER                       854
037F  C105 035A                  BRCL  NZ,C13              DO ANOTHER LINE                              855
0381  C107 02FD                  BRC   I,7,C1              WAIT FOR ANOTHER COMMAND                     856
                 .                                                                                      857
                 .                                                                                      858
                 .                                                                                      859
                 .                                                                                      860
                 .  *******                                                                             861
                 .  DISPLAY                                                                             862
                 .  *******                                                                             863
                 .                                                                                      864
0383  E0F1       C11             LDR   R,CADD,CF1          GET ADD OF LOCATION TO DISPLAY               865
0384  ED00 02BB                  BAL   I,RET,HEXA          CONVERT CORE CONTENTS TO ASCII               866
0386  9C02 040A                  STR   D,CA1,CBUD1         PUT MSD IN OUTPUT BUFFER                     867
0388  9C03 040B                  STR   D,CA2,CBUD1+1       PUT LSD IN OUTPUT BUFFER                     868
038A  E3F1 0000                  LDR   DX,CADD,0,CF1       PUT CORE VALUE IN REGISTER                   869
038C  ED00 02BB                  BAL   I,RET,HEXA          CONVERT ADDRESS TO ASCII                     870
038E  9C02 040D                  STR   D,CA1,CBUD2         PUT MSD IN OUTPUT BUFFER                     871
0390  9C03 040E                  STR   D,CA2,CBUD2+1       PUT LSD IN OUTPUT BUFFER                     872
0392  E101 0409                  LDR   I,CADD,CBUD         PUT ADDRESS IN REGISTER                      873
0394  ED00 0230                  BAL   I,RET,OUTPUT        OUTPUT BUFFER TO CRT                         874
0396  E20F 0412                  LDR   D,CF1,CSFLG         GET FLAG FOR SEQUENTIAL CHANGE               875
0398  C105 03C5                  BRCL  NZ,C23              GO BACK TO SEQUENTIAL IF FLAG SET            876
039A  C107 02FD                  BRC   I,7,C1              GO AGAIN                                     877
                 .                                                                                      878
                 .                                                                                      879
                 .                                                                                      880
                 .                                                                                      881
                 .  ******                                                                              882
                 .  CHANGE                                                                              883
                 .  ******                                                                              884
                 .                                                                                      885
039C  9BF9 0000  C12             STR   DX,CF2,0,CF1        CHANGE CORE CONTENTS                         886
039E  C107 0383                  BRC   I,7,C11             GO DISPLAY CORE CHANGE                       887
                 .                                                                                      888
                 .                                                                                      889
                 .                                                                                      890
                 .               PAGE                                                                   891
```

```
LOC   OBJECT CODE    CARD IMAGE

                     .
                     . ************************
                     . CHANGE CORE SEQUENTIALLY
                     . ************************
                     .
03A0  9C0F 0410      C20      STR   D,CF1,CSTRT            SAVE START OF CORE CHANGE
03A2  9C0F 0411               STR   D,CF1,CSTOR            SAVE ADDRESS AT WHICH TO STORE
03A4  401C                    LDR   IS,CV1,1               SET UP A CONSTANT 1
03A5  9C0C 0412               STR   D,CV1,CSFLG            SET FLAG FOR SEQUENTIAL CHANGE
03A7  ED00 0151      C21      BAL   I,RET,KEYMR            GET VALUE FOR CORE
03A9  400A                    LDR   IS,CZERO,0             SET UP ZERO REGISTER
03AA  6011                    ADD   IS,CADD,1              INCREMENT BUFFER POINTER
03AB  4015                    LDR   IS,CV3,1               SET UP A CONSTANT 1
03AC  51AC                    LDR   RX,CV1,CZERO,CADD      GET FIRST CHARACTER ENTERED
03AD  515D                    LDR   RX,CV2,CV3,CADD        GET SECOND CHARACTER ENTERED
03AE  AE7C                    SHS   LL,CV1,8               LEFT JUSTIFY FIRST CHARACTER
03AF  AE7D                    SHS   LL,CV2,8               CLEAR UPPER 8 BITS OF SECOND CHAR
03B0  AD7D                    SHS   RL,CV2,8               RIGHT JUSTIFY SECOND CHARACTER
03B1  80DC                    ADD   R,CV1,CV2              COMBINE BOTH CHARACTERS
03B2  B10C 646F               CMP   I,CV1,0646F            COMPARE WITH 'DO'
03B4  C102 03C1               BRCL  EQ,C22                 GET OUT IF DONE
03B6  ED00 02E2               BAL   I,RET,AHEX             CONVERT ENTRY TO HEX
03B8  E20F 0411               LDR   D,CF1,CSTOR            GET ADDRESS FOR STORING
03BA  9BF2 0000               STR   DX,CA1,0,CF1           PUT VALUE IN CORE
03BC  601F                    ADD   IS,CF1,1               INCREMENT STORE ADDRESS
03BD  9C0F 0411               STR   D,CF1,CSTOR            SAVE NEW STORE ADDRESS
03BF  C107 03A7               BRCL  U,C21                  GO GET ANOTHER ENTRY
03C1  E20F 0410      C22      LDR   D,CF1,CSTRT            GET ADDRESS OF FIRST CORE CHANGED
03C3  C107 0383               BRCL  U,C11                  GO DISPLAY LOCATION
03C5  E20C 0410      C23      LDR   D,CV1,CSTRT            GET ADDRESS DISPLAYED
03C7  601C                    ADD   IS,CV1,1               INCREMENT ADDRESS
03C8  9C0C 0410               STR   D,CV1,CSTRT            SAVE AS NEW DISPLAY ADDRESS
03CA  B20C 0411               CMP   D,CV1,CSTOR            COMPARE WITH LAST ADDRESS+1
03CC  C104 03C1               BRCL  LT,C22                 DO AGAIN IF NOT FINISHED
03CE  400C                    LDR   IS,CV1,0               GET A ZERO
03CF  9C0C 0412               STR   D,CV1,CSFLG            CLEAR SEQUENTIAL FLAG
03D1  C107 02FD               BRCL  U,C1                   GO GET ANOTHER COMMAND
                     .
                     .
                     .
                     . ****************
                     . DATA AND BUFFERS
                     . ****************
                     .
03D3                 CSAVE    DS    1                      ADDRESS OF ROUTINE CALLING CORE
                     .
                     .
03D4  001C           CBCNT    DC    28                     COUNT OF VALUES IN BUFFER TO OUTPUT
03D5                 CBUFF    DS    27                     OUTPUT BUFFER
03F0  0D0A                    DC    00D0A                  CR/LF
                     .
                     .
```

```
LOC   OBJECT CODE     CARD IMAGE                                                           CARDNUM
03F1                  CS1     DS    20           REG SAVE AREA FOR INTERNAL USE              945
                      .                                                                      946
                      .                                                                      947
0405  0003            CTITLE  DC    3            COUNT                                       948
0406  0D0A                    DC    00D0A        CR/LF                                       949
0407  434F                    DC    0434F        CO                                          950
0408  5245                    DC    05245        RE                                          951
                      .                                                                      952
0409  0006            CBUD    DC    6            COUNT                                       953
040A                  CBUD1   DS    2            2 LOCATIONS FOR ADDRESS                     954
                      .                                                                      955
040C  2020                    DC    02020        BLANKS                                      956
040D                  CBUD2   DS    2            2 LOCATIONS FOR CONTENTS                    957
040F  0D0A                    DC    00D0A        CR/LF                                       958
                      .                                                                      959
0410  0000            CSTRT   DC    0            START ADDRESS FOR SEQUENTIAL CORE           960
0411  0000            CSTOR   DC    0            CURRENT ADDRESS FOR STORING IN SEQ          961
0412  0000            CSFLG   DC    0            FLAG FOR SEQUENTIAL CHANGE                  962
                      .                                                                      963
                      .                                                                      964
                      .                                                                      965
                              END                                                            966
```

```
ATAC                                                              TIME: 16:43:42      03/18/77      PAGE     1
LOC    OBJECT CODE      CARD IMAGE                                                                    CARDNUM
                                  IDT    ATAC
0000                              DS     0500
                                  ENTRY  WJ
                        .
                        RET       EQU    0
                        OUTPUT    EQU    00230
                        KEYMB     EQU    00151
                        .
                        .
                        . *****************
                        . ESTABLISH EQUATES
                        . *****************
                        .
                        WJXS      EQU    1                      XAR START
                        WJXE      EQU    2                      XAR END
                        WJX1      EQU    3                      XAR 1
                        WJX2      EQU    4                      XAR 2
                        WJX3      EQU    5                      XAR 3
                        WJX4      EQU    6                      XAR 4
                        WJD1      EQU    7                      DATA 1
                        WJD2      EQU    8                      DATA 2
                        WJD3      EQU    9                      DATA 3
                        WJD4      EQU    10                     DATA 4
                        WJXX      EQU    11                     XAR FOR CHECK
                        WJV1      EQU    1                      VARIABLE 1
                        WJV2      EQU    2                      VARIABLE 2
                        WJV3      EQU    3                      VARIABLE 3
                        WJV4      EQU    4                      VARIABLE 4
                        WJV5      EQU    5                      VARIABLE 5
                        WJV6      EQU    6                      VARIABLE 6
                        WJV7      EQU    7                      VARIABLE 7
                        WJV8      EQU    8                      VARIABLE 8
                        WJV9      EQU    9                      VARIABLE 9
                        WJV10     EQU    10                     VARIABLE 10
                        WJV11     EQU    11                     VARIABLE 11
                        WJLPC     EQU    15                     WJS COUNTER
                        .
                        .
                        .
                        .
                        . *****
                        . ENTRY
                        . *****
0500   9C00 09AD        WJ        STR    D,RET,WJRET            SAVE RETURN ADDRESS
                        .
                        . *******************
                        . INITIALIZE RECEIVER
                        . *******************
                        .
0502   BC31 09BC        WJ01      LDRM   D,WJV1,WJI1,4          GET INITIAL CONTROL WORDS FOR RCVR
0504   9C31 09C8                  STRM   D,WJV1,WJCW1,4         PUT INITIAL VALUES INTO CONTROL
0506   BC71 09C0                  LDRM   D,WJV1,WJICD,8         GET INITIAL CONTROL WORD DISPLAY
0508   9C71 09D8                  STRM   D,WJV1,WJCFL,8         SAVE INITIAL CONTROL WORD DISPLAY
```

```
LOC   CBJECT CODE     CARD IMAGE                                                                    CARDNUM

050A  E603 09BB             LLC   D,WJX1,WJCRO          LOAD "ADDRESS ON"
050C  D932                  ROUT  02,WJX1               ENABLE RECEIVER/TURN ON INTERFACE
050D  E101 0000             LDR   I,WJXS,0              CLEAR REGISTER
050F  9C01 09F4             STR   D,WJXS,CHKFLG1        CLEAR FLAG
0511  9C01 09F6             STR   D,WJXS,WJLPK          ZERO WJS COUNTER
0513  ED00 08AE             BAL   I,RET,WJS             SEND INITIAL CONTROL WORD TO RCVR
0515  E101 0A02             LDR   I,WJV1,WJINS          GET ADDRESS OF INSTRUCTION BUFFER
0517  ED00 0230             BAL   I,RET,OUTPUT          OUTPUT INSTRUCTIONS TO CRT
0519  E101 09F7   WJ02      LDR   I,WJV1,WJT            GET ADDRESS OF TITLE BUFFER
051B  ED00 07AE             BAL   I,RET,WJ90            OUTPUT TITLE AND GET ENTRY
051D  C107 0519             BRCL  U,WJ02                ILLEGAL ENTRY
                  .
                  . *****************
                  . TRANSLATE COMMAND
                  . *****************
                  .
051F  2012                  CMP   IS,WJV2,1             COMPARE WITH ONE
0520  C105 0519             BRCL  NE,WJ02               WILL ONLY ACCEPT ONE CHAR
0522  2083                  CMP   IS,WJV3,8             COMPARE WITH MAX VALUE
0523  C101 0519             BRCL  GT,WJ02               ENTRY OUT OF RANGE
                  .
                  . ****************************
                  . BRANCH ACCORDING TO COMMAND
                  .****************************
                  .
0525  E330 0528             LDR   DX,RET,WJBRC,WJV3     GET ADDRESS FOR BRANCH FROM TABLE
0527  BF07                  BRC   R,7,RET               GO PROCESS ACCORDING TO COMMAND
                  .
                  . BRANCH TABLE FOR COMMANDS FROM OPERATOR
                  .
0528  0531        WJBRC     DC    WJ10                  0=SET UP TENTATIVE WORD
0529  05AE                  DC    WJ20                  1=DISPLAY TENTATIVE CONTROL WORD
052A  05C6                  DC    WJ30                  2=DISPLAY CONTROL WORD
052B  05DE                  DC    WJ40                  3=DISPLAY LAST RECEIVED WORD
052C  0614                  DC    WJ50                  4=ENTER TENTATIVE WORD AS NEW CONTRO
052D  0657                  DC    WJ60                  5=SCAN
052E  C790                  DC    WJ70                  6=RECEIVE CONTROL WORD FROM RCVR
052F  C7A8                  DC    WJ80                  7=DONE
0530  C502                  DC    WJ01                  8=REINITIALIZE
                  .
                  .
                  .
                  .
                  . ******************
                  . SET UP (COMMAND=0)
                  . ******************
                  .
                  . OUTPUT TITLE AND GET KEYBOARD ENTRY FOR FREQUENCY
                  .
0531  E101 0A4B   WJ10      LDR   I,WJV1,WJFB           GET ADDRESS OF FREQUENCY TITLE
0533  ED00 07AE             BAL   I,RET,WJ90            OUTPUT TITLE AND GET ENTRY
0535  C107 0531             BRCL  U,WJ10                ILLEGAL ENTRY
0537  ED00 07CC             BAL   I,RET,WJ91            MAKE SURE FREQUENCY IS LEGAL
```

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LOC   OBJECT CODE      CARD IMAGE                                                              CARDNUM
0539  C107 0531               BRCL  U,WJ10              ILLEGAL FREQUENCY                        108
053B  9C03 09D0               STR   D,WJV3,WJTFL        STORE TENTATIVE FREQUENCY (LOWER)        109
053D  9C04 09D1               STR   D,WJV4,WJTFU        STORE TENTATIVE FREQUENCY (UPPER)        110
                                                                                                 111
                 : OUTPUT TITLE AND GET KEYBOARD ENTRY FOR DETECT MODE                           112
                 :                                                                               113
053F  E101 0A89  WJ11         LDR   I,WJV1,WJDMB        GET ADDRESS OF DETECT MODE TITLE         114
0541  ED00 07AE               BAL   I,RET,WJ90          OUTPUT TITLE AND GET ENTRY               115
0543  C107 053F               BRCL  U,WJ11              ILLEGAL ENTRY                            116
0545  2073                    CMP   IS,WJV3,7           COMPARE WITH MAX VALUE                   117
0546  C101 053F               BRCL  GT,WJ11             TOO LARGE                                118
0548  9C03 09D2               STR   D,WJV3,WJTDM        SAVE TENTATIVE DETECT MODE               119
054A  E101 0004               LDR   I,WJV1,04           GET UPPER OF DEFAULT BFO FREQUENCY       120
054C  9C01 09D4               STR   D,WJV1,WJTBU        SAVE TENTATIVE BFO FREQUENCY (UPPER)     121
054E  E101 5500               LDR   I,WJV1,05500        GET LOWER OF DEFAULT BFO FREQUENCY       122
0550  9C01 09D3               STR   D,WJV1,WJTBL        SAVE TENTATIVE BFO FREQUENCY (LOWER)     123
0552  2033                    CMP   IS,WJV3,3           COMPARE DETECT MODE WITH BFO VARIABL     124
0553  C105 056E               BRCL  NE,WJ13             NOT VARIABLE BFO, USE DEFAULT FREQUE     125
                                                                                                 126
                 : OUTPUT TITLE AND GET KEYBOARD ENTRY FOR BFO FREQUENCY                         127
                 :                                                                               128
0555  E101 0AB3  WJ12         LDR   I,WJV1,WJBFB        GET ADDRESS OF BFO FREQUENCY TITLE       129
0557  ED00 07AE               BAL   I,RET,WJ90          OUTPUT TITLE AND GET ENTRY               130
0559  C107 0555               BRCL  U,WJ12              ILLEGAL ENTRY                            131
055B  2062                    CMP   IS,WJV2,6           COMPARE WITH EXACT COUNT                 132
055C  C105 0555               BRCL  NE,WJ12             WRONG COUNT                              133
055E  E833                    SHD   RL,WJV3,4           POSITION FREQUENCY (10 HZ RES)           134
055F  2044                    CMP   IS,WJV4,04          COMPARE UPPER WITH EXACT VALUE           135
0560  C105 0555               BRCL  NE,WJ12             ILLEGAL ENTRY                            136
0562  B103 4500               CMP   I,WJV3,04500        COMPARE LOWER WITH MIN VALUE             137
0564  C104 0555               BRCL  LT,WJ12             ILLEGAL ENTRY                            138
0566  B103 6500               CMP   I,WJV3,06500        COMPARE LOWER WITH MAX VALUE             139
0568  C101 0555               BRCL  GT,WJ12             ILLEGAL ENTRY                            140
056A  9C03 09D3               STR   D,WJV3,WJTBL        SAVE TENTATIVE BFO FREQUENCY (LOWER)     141
056C  9C04 09D4               STR   D,WJV4,WJTBU        SAVE TENTATIVE BFO FREQUENCY (UPPER)     142
                                                                                                 143
                 : OUTPUT TITLE AND GET KEYBOARD ENTRY FOR GAIN MODE                             144
                 :                                                                               145
056E  E101 0A53  WJ13         LDR   I,WJV1,WJGMB        GET ADDRESS OF GAIN MODE TITLE           146
0570  ED00 07AE               BAL   I,RET,WJ90          OUTPUT TITLE AND GET ENTRY               147
0572  C107 056E               BRCL  U,WJ13              ILLEGAL ENTRY                            148
0574  2033                    CMP   IS,WJV3,3           COMPARE WITH MAX VALUE                   149
0575  C101 056E               BRCL  GT,WJ13             ILLEGAL ENTRY                            150
0577  2013                    CMP   IS,WJV3,1           COMPARE WITH ENTRY FO 1                  151
0578  C102 056E               BRCL  EQ,WJ13             ILLEGAL ENTRY                            152
057A  E201 09D2               LDR   D,WJV1,WJTDM        GET TENTATIVE DETECT MODE                153
057C  2041                    CMP   IS,WJV1,4           COMPARE WITH ISB                         154
057D  C105 0582               BRCL  NE,WJ131            BRANCH IF NOT ISB                        155
057F  2003                    CMP   IS,WJV3,0           MAKE SURE GAIN MODE NOT HOLD AGC         156
0580  C102 056E               BRCL  EQ,WJ13             ILLEGAL ENTRY                            157
0582  9C03 09D5  WJ131        STR   D,WJV3,WJTGM        SAVE TENTATIVE GAIN MODE                 158
                                                                                                 159
                 : OUTPUT TITLE AND GET KEYBOARD ENTRY FOR IF BANDWIDTH                          160
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LOC   OBJECT CODE      CARD IMAGE                                                                          CARDNUM
                     .
0584  E201 0902                LDR   D,WJV1,WJTDM          GET TENTATIVE DETECT MODE
0586  2041                     CMP   IS,WJV1,4             COMPARE WITH ISE
0587  C104 058F                BRCL  LT,WJ14               NOT SIDEBAND-BRANCH
0589  2061                     CMP   IS,WJV1,6             COMPARE WITH USE
058A  C101 058F                BRCL  GT,WJ14               NOT SIDEBAND-BRANCH
058C  4043                     LDR   IS,WJV3,4             LOAD DEFAULT IF BANDWIDTH
058D  C107 059B                BRCL  U,WJ141               SKIP IF BANDWIDTH
058F  E101 0A6D      WJ14      LDR   I,WJV1,WJIFB          GET ADDRESS OF IF BANDWIDTH TITLE
0591  ED00 07AE                BAL   I,RET,WJ90            OUTPUT TITLE AND GET ENTRY
0593  C107 058F                BRCL  U,WJ14                ILLEGAL ENTRY
0595  2043                     CMP   IS,WJV3,4             COMPARE WITH MAX VALUE
0596  C101 058F                BRCL  GT,WJ14               ILLEGAL ENTRY
0598  2013                     CMP   IS,WJV3,1             COMPARE WITH MIN VALUE
0599  C104 058F                BRCL  LT,WJ14               ILLEGAL ENTRY
059B  9C03 09D7      WJ141     STR   D,WJV3,WJTIF          SAVE TENTATIVE IF BANDWIDTH
                     .
                     . OUTPUT TITLE AND GET KEYBOARD ENTRY FOR RF GAIN
                     .
059D  E101 0ACA      WJ15      LDR   I,WJV1,WJRFGB         GET ADDRESS OF RF GAIN TITLE
059F  ED00 07AE                BAL   I,RET,WJ90            OUTPUT TITLE AND GET ENTRY
05A1  C107 059D                BRCL  U,WJ15                ILLEGAL ENTRY
05A3  2032                     CMP   IS,WJV2,3             COMPARE WITH MAX COUNT
05A4  C101 059D                BRCL  GT,WJ15               ILLEGAL ENTRY
05A6  B103 0100                CMP   I,WJV3,0100           COMPARE WITH MAX VALUE
05A8  C101 059D                BRCL  GT,WJ15               ILLEGAL ENTRY
05AA  9C03 09D6                STR   D,WJV3,WJTRFG         SAVE TENTATIVE RF GAIN
                     .
05AC  C107 0519                BRCL  U,WJ02                GO GET ANOTHER COMMAND
                     .
                     .
                     .
                     .
                     . ***********************************************
                     . DISPLAY TENTATIVE CONTROL WORD (COMMAND=1)
                     . ***********************************************
                     .
05AE  E202 09D1      WJ20      LDR   D,WJV2,WJTFU          GET UPPER OF TENTATIVE FREQUENCY
05E0  E201 09D0                LDR   D,WJV1,WJTFL          GET LOWER OF TENTATIVE FREQUENCY
05E2  ED00 07D9                BAL   I,RET,WJ92            PUT FREQUENCY IN BUFFER AND DISPLAY
05E4  E201 09D5                LDR   D,WJV1,WJTGM          GET TENTATIVE GAIN MODE
05E6  E202 09D7                LDR   D,WJV2,WJTIF          GET TENTATIVE IF BANDWIDTH
05E8  ED00 0801                BAL   I,RET,WJ93            OUTPUT GAIN MODE AND IF BANDWIDTH
05EA  E201 09D2                LDR   D,WJV1,WJTDM          GET TENTATIVE DETECT MODE
05EC  E202 09D3                LDR   D,WJV2,WJTBL          GET TENTATIVE BFO FREQUENCY (LOWER)
05EE  ED00 0820                BAL   I,RET,WJ94            OUTPUT DETECT MODE AND BFO FREQUENCY
05C0  E201 09D6                LDR   D,WJV1,WJTRFG         GET TENTATIVE RF GAIN
05C2  ED00 084A                BAL   I,RET,WJ95            OUTPUT RF GAIN
05C4  C107 0519                BRCL  U,WJ02                DONE
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AD-A039 950 NAVAL POSTGRADUATE SCHOOL MONTEREY CALIF F/G 9/2
AN INTERACTIVE COMPUTER INTERFACE WITH A DIGITAL RECEIVER.(U)
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LOC    OBJECT CODE      CARD IMAGE                                                                              CARDNUM
                      . **********************************
                      . DISPLAY CONTROL WORD (COMMAND=2)
                      . **********************************
                      .
05C6   E202 09D9      WJ30      LDR    D,WJV2,WJCFU        GET UPPER OF CONTROL FREQUENCY
05C8   E201 09D8                LDR    D,WJV1,WJCFL        GET LOWER OF CONTROL FREQUENCY
05CA   ED00 07D9                BAL    I,RET,WJ92          OUTPUT FREQUENCY
05CC   E201 09DD                LDR    D,WJV1,WJCGM        GET CONTROL GAIN MODE
05CE   E202 09DF                LDR    D,WJV2,WJCIF        GET CONTROL IF BANDWIDTH
05D0   ED00 0801                BAL    I,RET,WJ93          OUTPUT GAIN MODE AND IF BANDWIDTH
05D2   E201 09DA                LDR    D,WJV1,WJCDM        GET CONTROL DETECT MODE
05D4   E202 09DB                LDR    D,WJV2,WJCBL        GET CONTROL BFO FREQUENCY (LOWER)
05D6   ED00 0820                BAL    I,RET,WJ94          OUTPUT DETECT MODE AND BFO FREQUENCY
05D8   E201 09DE                LDR    D,WJV1,WJCRFG       GET CONTROL RF GAIN
05DA   ED00 084A                BAL    I,RET,WJ95          OUTPUT RF GAIN
05DC   C107 0519                BRCL   U,WJ02              DONE
                      .
                      .
                      .
                      .
                      . **********************************
                      . DISPLAY RECEIVED WORD (COMMAND=3)
                      . **********************************
                      .
05DE   E202 09E1      WJ40      LDR    D,WJV2,WJRFU        GET UPPER OF RECEIVED FREQUENCY
05E0   E201 09E0                LDR    D,WJV1,WJRFL        GET LOWER OF RECEIVED FREQUENCY
05E2   ED00 07D9                BAL    I,RET,WJ92          OUTPUT FREQUENCY
05E4   E201 09E5                LDR    D,WJV1,WJRGM        GET RECEIVED GAIN MODE
05E6   E202 09E7                LDR    D,WJV2,WJRIF        GET RECEIVED IF BANDWIDTH
05E8   ED00 0801                BAL    I,RET,WJ93          OUTPUT GAIN MODE AND IF BANDWIDTH
05EA   E201 09E2                LDR    D,WJV1,WJRDM        GET RECEIVED DETECT MODE
05EC   E202 09E3                LDR    D,WJV2,WJRBL        GET RECEIVED BFO FREQUENCY (LOWER)
05EE   ED00 0820                BAL    I,RET,WJ94          OUTPUT DETECT MODE AND BFO FREQUENCY
05F0   E201 09E6                LDR    D,WJV1,WJRRFG       GET RECEIVED RF GAIN
05F2   ED00 084A                BAL    I,RET,WJ95          OUTPUT RF GAIN
05F4   E201 09E9                LDR    D,WJV1,WJRSS        GET RECEIVED SIGNAL STRENGTH
05F6   4002                     LDR    IS,WJV2,0           CLEAR REGISTER
05F7   F871                     SHD    LL,WJV1,8           POSITION 1ST DIGIT
05F8   A502 2030                IOR    I,WJV2,02030        CONVERT TO ASCII
05FA   9C02 0B22                STR    D,WJV2,WJDSS1       STORE IN OUTPUT BUFFER
05FC   4002                     LDR    IS,WJV2,0           CLEAR REGISTER
05FD   F831                     SHD    LL,WJV1,4           POSITION LAST 2 DIGITS
05FE   AE32                     SHS    LL,WJV2,4
05FF   F831                     SHD    LL,WJV1,4
0600   A502 3030                IOR    I,WJV2,03030        CONVERT TO ASCII
0602   9C02 0B23                STR    D,WJV2,WJDSS1+1     STORE IN OUTPUT BUFFER
0604   E101 0B18                LDR    I,WJV1,WJDSS        GET ADDRESS OF BUFFER TO OUTPUT
0606   ED00 0230                BAL    I,RET,OUTPUT        OUTPUT BUFFER
0608   C107 0519                BRCL   U,WJ02              DONE
060A                            DS     10                  SPACE FOR PATCHES
                      .
                      .
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LOC   OBJECT CODE      CARD IMAGE                                                                CARDNUM
                    .                                                                              267
                    . *******************************************                                  268
                    . ENTER TENTATIVE CONTROL WORD (COMMAND=4)                                     269
                    . *******************************************                                  270
                    .                                                                              271
0614  BC71 09D0     WJ50    LDRM  D,WJV1,WJTFL,8      GET TENTATIVE VALUES IN DISPLAY FORM         272
0616  9C71 09D8             STRM  D,WJV1,WJCPL,8      STORE IN CONTROL VALUES IN DISPLAY F         273
0618  F831                  SHD   LL,WJV1,4           POSITION FREQUENCY                           274
0619  9C02 09C8             STR   D,WJV2,WJCW1        SET UP CONTROL WORD 1                        275
061B  AE16                  SHS   LL,WJV6,2           POSITION GAIN MODE                           276
061C  A461                  IOR   R,WJV1,WJV6         PUT IN CW 2                                  277
061D  E082                  LDR   R,WJV2,WJV8         GET IF BANDWIDTH                             278
061E  AD02                  SHS   RL,WJV2,1           POSITION BANDWIDTH                           279
061F  A421                  IOR   R,WJV1,WJV2         PUT IN CW 2                                  280
0620  9C01 09C9             STR   D,WJV1,WJCW2        STORE CONTROL WORD 2                         281
0622  E081                  LDR   R,WJV1,WJV8         GET IF BANDWIDTH                             282
0623  AEE1                  SHS   LL,WJV1,15          POSITION LAST DIGIT OF BANDWIDTH             283
0624  AEB3                  SHS   LL,WJV3,12          POSITION DETECT MODE                         284
0625  A431                  IOR   R,WJV1,WJV3         PUT DETECT MODE IN CW 3                      285
0626  9C01 09CA             STR   D,WJV1,WJCW3        SAVE CW 3                                    286
0628  E042                  LDR   R,WJV2,WJV4         GET BFO LOWER VALUE                          287
0629  ED00 098E             BAL   I,RET,WJBCDH        CONVERT BCD VALUE TO HEX                     288
062B  E501 1194             SUB   I,WJV1,4500         SUBTRACT 4500 FROM VALUE                     289
062D  CD01 07FF             MUL   I,WJV1,07FF         MULTIPLY BY 7FF                              290
062F  E103 07D0             LDR   I,WJV3,2000         SET UP DIVISOR                               291
0631  8101 0373             ADD   I,WJV1,0373         ROUND                                        292
0633  FC31                  DIV   R,WJV1,WJV3         DIVIDE                                       293
0634  E023                  LDR   R,WJV3,WJV2         EXCHANGE REGISTERS                           294
0635  F201 09CA     WJ503   LDR   D,WJV1,WJCW3        GET REST OF CW 3                             295
0637  A431                  IOR   R,WJV1,WJV3         GET BFO FREQUENCY INTO CW 3                  296
0638  9C01 09CA             STR   D,WJV1,WJCW3        STORE CONTROL WORD 3                         297
063A  E202 09D6             LDR   D,WJV2,WJTRFG       GET RF GAIN VALUE                            298
063C  ED00 098E             BAL   I,RET,WJBCDH        CONVERT BCD TO HEX                           299
063E  CD01 007F             MUL   I,WJV1,07F          MULTIPLY BY 7F                               300
0640  6321                  ADD   IS,WJV1,032         ROUND                                        301
0641  4643                  LDR   IS,WJV3,064         SET UP DIVISOR                               302
0642  FC31                  DIV   R,WJV1,WJV3         DIVIDE                                       303
0643  8421                  LLC   R,WJV1,WJV2         GET VALUE COMPLEMENTED FOR WJ                304
0644  A101 007F             AND   I,WJV1,07F          CLEAR ALL BUT VALUE WANTED                   305
0646  AE71                  SHS   LL,WJV1,8           POSITION RF GAIN                             306
0647  9C01 09CB             STR   D,WJV1,WJCW4        STORE CONTROL WORD 4                         307
0649  ED00 08AE             BAL   I,RET,WJS           OUTPUT CONTROL WORD TO WJ                    308
064B  C107 0519             BRCL  U,WJ02              DONE                                         309
064D                        DS    10                  SPACE FOR PATCHES                            310
                    .                                                                              311
                    .                                                                              312
                    .                                                                              313
                    . ****************                                                             314
                    . SCAN (CCMMAND=5)                                                             315
                    . ****************                                                             316
                    .                                                                              317
                    .                                                                              318
0657  4001          WJ60    LDR   IS,WJV1,0           CLEAR REGISTER                               319
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LOC   OBJECT CODE    CARD IMAGE                                                              CARDNUM
0658  9C01 09F0              STR   D,WJV1,WJSCNT        INITIALIZE PASS COUNT                     320
065A  E101 0B97              LDR   I,WJV1,WJSCAN        GET ADDRESS OF SCAN TITLE                 321
065C  ED00 0230              BAL   I,RET,OUTPUT         OUTPUT SCAN TITLE                         322
065E                         DS    10                   SPACE FOR PATCHES                         323
                   .                                                                              324
                   . OUTPUT TITLE AND GET LOWER FREQUENCY LIMIT                                   325
                   .                                                                              326
0668  E101 0B9C    WJ601     LDR   I,WJV1,WJSFS         GET ADDRESS OF START FREQUENCY TITLE      327
066A  ED00 07AE              BAL   I,RET,WJ90           OUTPUT TITLE AND GET ENTRY                328
066C  C107 0668              BRCL  U,WJ601              ILLEGAL ENTRY                             329
066E  ED00 07CC              BAL   I,RET,WJ91           MAKE SURE FREQ IS IN LEGAL BOUNDS         330
0670  C107 0668              BRCL  U,WJ601              ILLEGAL ENTRY                             331
0672  9C03 09ED              STR   D,WJV3,WJSFLL        SAVE LOWER LIMIT (LOWER)                  332
0674  9C04 09EC              STR   D,WJV4,WJSFLU        SAVE LOWER LIMIT (UPPER)                  333
0676                         DS    10                   SPACE FOR PATCHES                         334
                   .                                                                              335
                   . OUTPUT TITLE AND GET UPPER FREQUENCY LIMIT                                   336
                   .                                                                              337
0680  E101 0BA7    WJ602     LDR   I,WJV1,WJSFE         GET ADDRESS OF END FREQ TITLE             338
0682  ED00 C7AE              BAL   I,RET,WJ90           OUTPUT TITLE AND GET ENTRY                339
0684  C107 0680              BRCL  U,WJ602              ILLEGAL ENTRY                             340
0686  ED00 07CC              BAL   I,RET,WJ91           MAKE SURE FREQ IS IN LEGAL BOUNDS         341
0688  C107 0680              BRCL  U,WJ602              ILLEGAL ENTRY                             342
068A  9C03 09EB              STR   D,WJV3,WJSFUL        SAVE UPPER LIMIT (LOWER)                  343
068C  9C04 09EA              STR   D,WJV4,WJSFUU        SAVE UPPER LIMIT (UPPER)                  344
068E                         DS    10                   SPACE FOR PATCHES                         345
                   .                                                                              346
                   . MAKE SURE UPPER LIMIT GREATER THAN LOWER LIMIT                               347
                   .                                                                              348
0698  E205 09EC              LDR   D,WJV5,WJSFLU        GET LOWER LIMIT (UPPER)                   349
069A  B054                   CMP   R,WJV4,WJV5          COMPARE UPPER AND LOWER LIMITS' (UPPE     350
069B  C104 0668              BRCL  LT,WJ601             UPPER LIMIT LESS THAN LOWER               351
069D  C101 06AE              BRCL  GT,WJ603             NO NEED TO CHECK FURTHER                  352
069F  E205 09ED              LDR   D,WJV5,WJSFLL        GET LOWER LIMIT (LOWER)                   353
06A1  B053                   CMP   R,WJV3,WJV5          COMPARE UPPER AND LOWER LIMITS (LOWE      354
06A2  C106 0668              BRCL  LE,WJ601             LESS OR EQUAL, TRY AGAIN                  355
06A4                         DS    10                   SPACE FOR PATCHES                         356
                   .                                                                              357
                   . OUTPUT TITLE AND GET FREQUENCY INCREMENT (8000HZ MAX)                        358
                   .                                                                              359
06AE  E101 0BB1    WJ603     LDR   I,WJV1,WJSFI         GET ADDRESS OF FREQ INC TITLE             360
06B0  ED00 07AE              BAL   I,RET,WJ90           OUTPUT TITLE AND GET ENTRY                361
06B2  C107 06AE              BRCL  U,WJ603              ILLEGAL ENTRY                             362
06B4  E833                   SHD   RL,WJV3,4            POSITION INCREMENT                        363
06B5  2042                   CMP   IS,WJV2,4            COMPARE COUNT WITH MAX                    364
06B6  C101 06AE              BRCL  GT,WJ603             ILLEGAL - TOO LARGE                       365
06B8  B103 0800              CMP   I,WJV3,0800          COMPARE WITH MAX INCREMENT                366
06BA  C101 06AE              BRCL  GT,WJ603             ILLEGAL - TOO LARGE                       367
06BC  2013                   CMP   IS,WJV3,1            COMPARE WITH MIN INCREMENT                368
06BD  C104 06AE              BRCL  LT,WJ603             ILLEGAL - TOO SMALL                       369
06BF  9C03 09EE              STR   D,WJV3,WJSFIN        SAVE INCREMENT                            370
06C1                         DS    10                   SPACE FOR PATCHES                         371
                   .                                                                              372
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LOC   OBJECT CODE      CARD IMAGE                                                                            CARDNUM
                       . OUTPUT TITLE AND GET SIGNAL STRENGTH
                       .
06CB  E101 0BBE        WJ604    LDR   I,WJV1,WJSSS         GET ADDRESS OF SIGNAL STRENGTH TITLE
06CD  ED00 07AE                 BAL   I,RET,WJ90           OUTPUT TILE AND GET ENTRY
06CF  C107 06CB                 BRCL  U,WJ604              ILLEGAL ENTRY
06D1  B103 0100                 CMP   I,WJV3,0100          COMPARE WITH MAX VALUE
06D3  C101 06CB                 BRCL  GT,WJ604             ILLEGAL - TOO LARGE
06D5  2032                      CMP   IS,WJV2,3            COMPARE COUNT WITH MAX
06D6  C101 06CB                 BRCL  GT,WJ604             ILLEGAL - TOO LARGE
06D8  E032                      LDR   R,WJV2,WJV3          PUT SIGNAL STRENGTH IN REG 2
06D9  ED00 098E                 BAL   I,RET,WJBCDH         CONVERT BCD TO HEX
06DB  CD01 007F                 MUL   I,WJV1,07F           MULTIPLY BY 127
06DD  6321                      ADD   IS,WJV1,032          ROUND
06DE  4643                      LDR   IS,WJV3,064          SET UP DIVISOR
06DF  FC31                      DIV   R,WJV1,WJV3          DIVIDE BY 100
06E0  A102 007F                 AND   I,WJV2,07F           CLEAR ALL BUT VALUE WANTED
06E2  9C02 09EF                 STR   D,WJV2,WJSFSS        STORE DESIRED SIGNAL STRENGTH
06E4                            DS    10                   SPACE FOR PATCHES
                       .
                       . OUTPUT FREQUENCY TO RECEIVER AND GET RESPONSE
                       .
06EE  E205 09ED        WJ605    LDR   D,WJV5,WJSFLL        GET LOWER LIMIT (LOWER)
06F0  E206 09EC                 LDR   D,WJV6,WJSFLU        GET LOWER LIMIT (UPPER)
06F2  F835             WJ606    SHD   LL,WJV5,4            POSITION FREQUENCY FOR WJ
06F3  E203 09C9                 LDR   D,WJV3,WJCW2         GET CONTROL WORD 2 (FREQ LOWER)
06F5  E204 09C8                 LDR   D,WJV4,WJCW1         GET CONTROL WORD 1 (FREQ UPPER)
06F7  A103 000F                 AND   I,WJV3,0F            CLEAR OLD FREQ (LOWER)
06F9  A104 0000                 AND   I,WJV4,0             CLEAR OLD FREQ (UPPER)
06FB  A453                      IOR   R,WJV3,WJV5          PUT IN NEW FREQ (LOWER)
06FC  A464                      IOR   R,WJV4,WJV6          PUT IN NEW FREQ (UPPER)
06FD  9C03 09C9                 STR   D,WJV3,WJCW2         SAVE NEW CONTROL WORD 2
06FF  9C04 09C8                 STR   D,WJV4,WJCW1         SAVE NEW CONTROL WORD 1
0701  ED00 08AE                 BAL   I,RET,WJS            SEND /RECEIVE NEW CONTROL WORD
0703                            DS    10                   SPACE FOR PATCHES
                       .
                       . COMPARE RECEIVED SIGNAL STRENGTH WITH SET SIGNAL STRENGTH
                       .
070D  E201 09CF                 LDR   D,WJV1,WJRS4         GET RECEIVED WORD 4
070F  A101 007F                 AND   I,WJV1,07F           CLEAR ALL BUT SIGNAL STRENGTH
0711  E202 09EF                 LDR   D,WJV2,WJSFSS        GET SPECIFIED SIGNAL STRENGTH
0713  B021                      CMP   R,WJV1,WJV2          COMPARE RECEIVED WITH SPECIFIED
0714  C103 074E                 BRCL  GE,WJ609             FIND
0716                            DS    10                   SPACE FOR PATCHES
                       .
                       . INCREMENT FREQUENCY AND TRY AGAIN
                       .
0720  E201 09C9                 LDR   D,WJV1,WJCW2         GET LAST FREQ (LOWER)
0722  E202 09C8                 LDR   D,WJV2,WJCW1         GET LAST FREQ (UPPER)
0724  F831                      SHD   RL,WJV1,4            POSITION FOR INCREMENT
0725  A102 03FF                 AND   I,WJV2,03FF          CLEAR ALL BUT FREQUENCY
0727  E203 09EE                 LDR   D,WJV3,WJSFIN        GET INCREMENT
0729  4004                      LDR   IS,WJV4,0            CLEAR REGISTER
072A  ED00 0861                 BAL   I,RET,WJ96           INCREMENT FREQUENCY
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LOC   OBJECT CODE    CARD IMAGE

072C  E201 09EB                LDR    D,WJV1,WJSFUL         GET UPPER LIMIT (LOWER)
072E  E202 09EA                LDR    D,WJV2,WJSFUU         GET UPPER LIMIT (UPPER)
0730  B062                     CMP    R,WJV2,WJV6           COMPARE UPPER LIMIT AND FREQ (UPPER)
0731  C101 06F2                BRCL   GT,WJ606              FREQ BELOW LIMIT, KEEP LOOKING
0733  C102 073F                BRCL   EQ,WJ608              UPPER FREQ MATCH,CHECK LOWERS
0735  E201 09F0       WJ607    LDR    D,WJV1,WJSCNT         GET COUNT OF NO. OF TIME THRU
0737  6011                     ADD    IS,WJV1,1             INCREMENT COUNT
0738  2641                     CMP    IS,WJV1,100           COMPARE WITH MAX TIMES THRU
0739  C101 075E                BRCL   GT,WJ610              DONE - NO FIND
073B  9C01 09F0                STR    D,WJV1,WJSCNT         SAVE NEW COUNT
073D  C107 06EE                BRCL   U,WJ605               GO START AT LOWER LIMIT AGAIN
073F  B051            WJ608    CMP    R,WJV1,WJV5           COMPARE LOWERS OF UPPER LIMIT AND FR
0740  C104 0735                BRCL   LT,WJ607              LESS, GO START AGAIN
0742  C107 06F2                BRCL   U,WJ606               GO DO WITH NEW FREQUENCY
0744                           DS     10                    SPACE FOR PATCHES
                      .
                      . FIND
                      .
C74E  BC11 09E0       WJ609    LDRM   D,WJV1,WJRFL,2        GET RECEIVED FREQUENCY (DISPLAY)
0750  9C11 09D8                STRM   D,WJV1,WJCPL,2        STORE IN CONTROL FREQ (DISPLAY)
0752  C107 05DE                BRCL   U,WJ40                GO DISPLAY RECEIVED WORD
0754                           DS     10                    SPACE FOR PATCHES
                      .
                      . NO FINE - TELL OPERATOR
                      .
075E  BC11 09E0       WJ610    LDRM   D,WJV1,WJRFL,2        GET LAST RECEIVED FREQ (DISPLAY)
0760  9C11 09D8                STRM   D,WJV1,WJCFL,2        STORE IN CONTROL FREQ (DISPLAY)
0762  E101 0ECA                LDR    I,WJV1,WJSNF          GET ADDRESS OF NO FIND MESSAGE
0764  ED00 0230                BAL    I,RET,OUTPUT          OUTPUT MESSAGE
0766  C107 0519                BRCL   U,WJ02                DONE
0768                           DS     40                    SPACE FOR PATCHES
                      .
                      .
                      .
                      .
                      . ************************************************
                      . RECEIVE CONTROL WORD FROM RECEIVER (COMMAND=6)
                      . ************************************************
                      .
0790  E101 0001       WJ70     LDR    I,WJV1,01             LOAD FLAG TO INHIBIT COMPARE
0792  9C01 09F4                STR    D,WJV1,CHKFLG1        STORE FLAG
0794  ED00 08E1                BAL    I,RET,WJR             INPUT RECEIVER CONTROL WORDS
0796  E101 0000                LDR    I,WJV1,0              ZERO REGISTER
0798  9C01 09F4                STR    D,WJV1,CHKFLG1        CLEAR FLAG
079A  C107 05DE                BRCL   U,WJ40                DISPLAY RECEIVED WORDS
079C  C107 0519                BRCL   U,WJ02                RETURN
079E                           DS     10                    SPACE FOR PATCHES
                      .
                      .
                      .
                      .
                      . ***************
                      . DONE (COMMAND=7)
```

```
LOC   OBJECT CODE     CARD IMAGE                                                          CARDNUM
                    . ***************
                    .
07A8  B601 09B4     WJ80     LLC   D,WJV1,WJCRF           LOAD "ADDRESS OFF"
07AA  D912                   ROUT  02,WJV1                TURN OFF INTERFACE
07AB  E200 09AD              LDR   D,RET,WJRET            LOAD RETURN ADDRESS
07AD  BF07                   BRC   R,7,RET                RETURN TO CALLER
                    .
                    .
                    .
                    .**********************************************************************
                    . ROUTINE TO OUTPUT BUFFER AND GET ENTRY FROM KEYBCARD
                    . ENTRY: WJV1 ADDRESS OF BUFFER TO BE OUTPUT
                    . EXIT:  WJV2 NUMBER OF CHARACTERS ENTERED
                    .        WJV3 ENTRY (LOWER) BCD
                    .        WJV4 ENTRY (UPPER) BCD
                    . RETUEN FOR ILLEGAL ENTRY
                    . RETURN+2 FOR LEGAL ENTRY
                    .**********************************************************************
                    .
07AE  9C00 09F1     WJ90     STR   D,RET,WJ90R            SAVE THE RETURN ADDRESS
07B0  ED00 0230              BAL   I,RET,OUTPUT           OUTPUT BUFFER
07B2  ED00 0151              BAL   I,RET,KEYMR            GET INPUT FROM KEYBOARD
07B4  4003                   LDR   IS,WJV3,0              CLEAR REGISTER
07B5  4004                   LDR   IS,WJV4,0              CLEAR REGISTER
07B6  4005                   LDR   IS,WJV5,0              CLEAR REGISTER
07B7  5152                   LDR   RX,WJV2,WJV5,WJV1      GET COUNT FROM KEYMR
07B8  E027                   LDR   R,WJV7,WJV2            SET UP INDEX FOR LOOP
07B9  E200 09F1              LDR   D,RET,WJ90R            GET RETURN ADDRESS
07BB  6FF7                   ADD   IS,WJV7,-1             DECREMENT COUNT
07BC  BF04                   BRC   R,4,RET                ILLEGAL IF NEG, NOTHING ENTERED
07BD  6011          WJ901    ADD   IS,WJV1,1              INCREMENT BUFFER POINTER
07BE  5156                   LDR   RX,WJV6,WJV5,WJV1      GET ONE CHARACTER
07BF  2306                   CMP   IS,WJV6,030            COMPARE CHAR WITH ASCII ZERO
07C0  BF04                   BRC   R,4,RET                ILLEGAL CHARACTER IS LESS
07C1  2396                   CMP   IS,WJV6,039            COMPARE WITH ASCII 9
07C2  BF01                   BRC   R,1,RET                ILLEGAL CHARACTER IS GREATER
07C3  A106 000F              AND   I,WJV6,0F              CLEAR UPPER 12 BITS
07C5  F833                   SHD   LL,WJV3,4              POSITION ENTRY FOR NEW CHARACTER
07C6  A463                   IOR   R,WJV3,WJV6            OR IN NEW CHARACTER
07C7  6FF7                   ADD   IS,WJV7,-1             DECREMENT COUNT
07C8  C103 07BD              BRCL  NN,WJ901               KEEP GOING IF MORE CHARACTERS
07CA  6020                   ADD   IS,RET,2               INCREMENT RETURN ADDRESS
07CB  BF07                   BRC   R,7,RET                LEGAL RETURN
                    .
                    .
                    .
                    .**********************************************************************
                    . ROUTINE TO CHECK A FREQUENCY ENTRY AND MAKE SURE IT IS IN WJ
                    . FREQUENCY LIMITS
                    . ENTRY: WJV2  NUMBER OF CHARACTERS ENTERED
                    .        WJV3 FREQUENCY (LOWER) BCD,1 HZ RESOLUTION
```

```
LOC   OBJECT CODE     CARD IMAGE                                                                      CARDNUM
                      .        WJV4 FREQUENCY (UPPER) BCD,1HZ RESOLUTION                                  532
                      . EXIT:  WJV3 FREQUENCY (LOWER) BCD,10 HZ RESOLUTION                                533
                      .        WJV4 FREQUENCY (UPPER) BCD,10 HZ RESOLUTION                                534
                      . RETURN FOR ILLEGAL ENTRY                                                          535
                      . RETURN+2 FOR LEGAL ENTRY                                                          536
                      .*********************************************************************              537
                      .                                                                                   538
07CC  2082            WJ91     CMP   IS,WJV2,8           COMPARE WITH MAX COUNT                           539
07CD  BF01                     BRC   R,1,RET             ILLEGAL - TOO MANY                               540
07CE  2062                     CMP   IS,WJV2,6           COMPARE COUNT WITH MIN                           541
07CF  BF04                     BRC   R,4,RET             ILLEGAL - TOO FEW                                542
07D0  E833                     SHD   RL,WJV3,4           POSITION FREQUENCY FOR WJ                        543
07D1  B104 0305                CMP   I,WJV4,0305         COMPARE WITH MAX FREQUENCY                       544
07D3  BF01                     BRC   R,1,RET             ILLEGAL - TOO LARGE                              545
07D4  B104 0005                CMP   I,WJV4,05           COMPARE WITH MIN FREQUENCY                       546
07D6  BF04                     BRC   R,4,RET             ILLEGAL - TOO SMALL                              547
07D7  6020                     ADD   IS,RET,2            INCREMENT RETURN ADDRESS                         548
07D8  BF07                     BRC   R,7,RET             LEGAL RETURN                                     549
                      .                                                                                   550
                      .                                                                                   551
                      .                                                                                   552
                      .                                                                                   553
                      .*********************************************************************              554
                      . ROUTINE TO DISPLAY FREQUENCY                                                      555
                      . WJV1 FREQUENCY (LOWER) IN DISPLAY FORMAT                                          556
                      . WJV2 FREQUENCY (UPPER) IN DISPLAY FORMAT                                          557
                      .*********************************************************************              558
                      .                                                                                   559
07D9  9C00 09F1       WJ92     STR   D,RET,WJ90R         SAVE RETURN ADDRESS                              560
07DB  E104 3030                LDR   I,WJV4,03030        SET UP ASCII CONVERSION CONSTANT                 561
07DD  4003                     LDR   IS,WJV3,0           CLEAR REGISTER                                   562
07DE  F831                     SHD   LL,WJV1,4           SET FREQUENCY TO 1 HZ RESOLUTION                 563
07DF  F832                     SHD   LL,WJV2,4           POSITION 1ST 2 DIGITS                            564
07E0  AE33                     SHS   LL,WJV3,4                                                            565
07E1  F832                     SHD   LL,WJV2,4                                                            566
07E2  A443                     IOR   R,WJV3,WJV4         CONVERT TO ASCII                                 567
07E3  9C03 0ADD                STR   D,WJV3,WJDP1        PUT 1ST 2 DIGITS IN DISPLAY BUFFER               568
07E5  4003                     LDR   IS,WJV3,0           CLEAR REGISTER                                   569
07E6  F832                     SHD   LL,WJV2,4           POSITION 2ND 2 DIGITS                            570
07E7  AE33                     SHS   LL,WJV3,4                                                            571
07E8  F832                     SHD   LL,WJV2,4                                                            572
07E9  A443                     IOR   R,WJV3,WJV4         CONVERT TO ASCII                                 573
07EA  9C03 0ADE                STR   D,WJV3,WJDP1+1      PUT IN DISPLAY BUFFER                            574
07EC  4002                     LDR   IS,WJV2,0           CLEAR REGISTER                                   575
07ED  F831                     SHD   LL,WJV1,4           POSITION 3RD 2 DIGITS                            576
07EE  AE32                     SHS   LL,WJV2,4                                                            577
07EF  F831                     SHD   LL,WJV1,4                                                            578
07F0  A442                     IOR   R,WJV2,WJV4         CONVERT TO ASCII                                 579
07F1  9C02 0ADF                STR   D,WJV2,WJDP1+2      PUT IN DISPLAY BUFFER                            580
07F3  4002                     LDR   IS,WJV2,0           CLEAR REGISTER                                   581
07F4  F831                     SHD   LL,WJV1,4           POSITION LAST 2 DIGITS                           582
07F5  AE32                     SHS   LL,WJV2,4                                                            583
07F6  F831                     SHD   LL,WJV1,4                                                            584
```

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LOC   OBJECT CODE     CARD IMAGE                                                          CARDNUM
07F7  A442                    IOR    R,WJV2,WJV4            CONVERT TO ASCII
07F8  9C02 0AE0               STR    D,WJV2,WJDF1+3         PUT IN DISPLAY BUFFER
07FA  E101 0AC8               LDR    I,WJV1,WJDF            GET ADDRESS OF OUTPUT BUFFER
07FC  ED00 0230               BAL    I,RET,OUTPUT           OUTPUT BUFFER
07FE  E200 09F1               LDR    D,RET,WJ90R            GET RETURN ADDRESS
0800  BF07                    BRC    R,7,RET                RETURN TO CALLER
                 .
                 .
                 .
                 .
                 .*****************************************************************
                 . ROUTINE TO DISPLAY GAIN MODE AND IF BANDWIDTH
                 . WJV1 GAIN MODE IN DISPLAY FORMAT
                 . WJV2 IF BANDWIDTH IN DISPLAY FORMAT
                 .*****************************************************************
                 .
0801  9C00 09F1  WJ93         STR    D,RET,WJ90R            SAVE RETURN ADDRESS
0803  9C02 09F2               STR    D,WJV2,WJ90S1          SAVE IF BANDWIDTH
0805  9C01 09F3               STR    D,WJV1,WJ90S2          SAVE GAIN MODE
0807  E101 0AFB               LDR    I,WJV1,WJDGM           GET ADDRESS OF BUFFER TO OUTPUT
0809  ED00 0230               BAL    I,RET,OUTPUT           OUTPUT BUFFER
080B  E202 09F3               LDR    D,WJV2,WJ90S2          PUT GAIN MODE IN REG 2
080D  E103 0B27               LDR    I,WJV3,WJGMTB          GET ADDRESS OF GAIN MODE TABLE
080F  5321                    LDR    RX,WJV1,WJV2,WJV3      GET ADDRESS OF BUFFER TO OUTPUT
0810  ED00 0230               BAL    I,RET,OUTPUT           OUTPUT BUFFER
0812  E101 0B03               LDR    I,WJV1,WJDIF           GET ADDRESS OF BUFFER TO OUTPUT
0814  ED00 0230               BAL    I,RET,OUTPUT           OUTPUT BUFFER
0816  E202 09F2               LDR    D,WJV2,WJ90S1          GET IF BANDWIDTH
0818  E103 0B42               LDR    I,WJV3,WJIFTB          GET ADDRESS OF IF BANDWIDTH TABLE
081A  5321                    LDR    RX,WJV1,WJV2,WJV3      GET ADDRESS OF BUFFER TO OUTPUT
081B  ED00 0230               BAL    I,RET,OUTPUT           OUTPUT IF BANDWIDTH BUFFER
081D  E200 09F1               LDR    D,RET,WJ90R            GET RETURN ADDRESS
081F  BF07                    BRC    R,7,RET                RETURN TO CALLER
                 .
                 .
                 .
                 .
                 .*****************************************************************
                 . ROUTINE TO DISPLAY DETECT MODE AND BFO FREQUENCY
                 . WJV1 DETECT MODE IN DISPLAY FORMAT
                 . WJV2 BFO FREQUENCY (LOWER) IN DISPLAY FORMAT
                 .*****************************************************************
                 .
0820  9C00 09F1  WJ94         STR    D,RET,WJ90R            SAVE RETURN ADDRESS
0822  9C01 09F2               STR    D,WJV1,WJ90S1          SAVE DETECT MODE
0824  9C02 09F3               STR    D,WJV2,WJ90S2          SAVE BFO FREQUENCY
0826  E101 0AE5               LDR    I,WJV1,WJDDM           GET ADDRESS OF BUFFER TO OUTPUT
0828  ED00 0230               BAL    I,RET,OUTPUT           OUTPUT BUFFER
082A  E202 09F2               LDR    D,WJV2,WJ90S1          GET DETECT MODE
082C  E103 0B61               LDR    I,WJV3,WJDMTB          GET ADDRESS OF DETECT MODE TABLE
082E  5321                    LDR    RX,WJV1,WJV2,WJV3      GET ADDRESS OF BUFFER TO OUTPUT
082F  ED00 0230               BAL    I,RET,OUTPUT           OUTPUT BUFFER
0831  E201 09F3               LDR    D,WJV1,WJ90S2          GET BFO FREQUENCY
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LOC   OBJECT CODE      CARD IMAGE                                                                               CARDNUM
0833  4002                     LDR    IS,WJV2,0              CLEAR REGISTER
0834  F831                     SHD    LL,WJV1,4              POSITION UPPER 2 DIGITS
0835  AE32                     SHS    LL,WJV2,4
0836  F831                     SHD    LL,WJV1,4
0837  A502 3030                IOR    I,WJV2,03030           CONVERT TO ASCII
0839  9C02 0AF5                STR    D,WJV2,WJDBF1          STORE IN OUTPUT BUFFER
083B  4002                     LDR    IS,WJV2,0              CLEAR REGISTER
083C  F831                     SHD    LL,WJV1,4              POSITION LOWER 2 DIGITS
083D  AE32                     SHS    LL,WJV2,4
083E  F831                     SHD    LL,WJV1,4
083F  A502 3030                IOR    I,WJV2,03030           CONVERT TO ASCII
0841  9C02 0AF6                STR    D,WJV2,WJDBF1+1        STORE IN OUTPUT BUFFER
0843  E101 0AEE                LDR    I,WJV1,WJDBF           GET ADDRESS OF BUFFER TO OUTPUT
0845  ED00 0230                BAL    I,RET,OUTPUT           OUTPUT BUFFER
0847  E200 09F1                LDR    D,RET,WJ90R            GET RETURN ADDRESS
0849  BF07                     BRC    R,7,RET                RETURN TO CALLER
                    .
                    .
                    .
                    .*************************************************************************
                    . ROUTINE TO DISPLAY RF GAIN
                    . WJV1 RF GAIN IN DISPLAY FORMAT
                    .*************************************************************************
                    .
C84A  9C00 09F1     WJ95       STR    D,RET,WJ90R            SAVE RETURN ADDRESS
084C  4002                     LDR    IS,WJV2,0              CLEAR REGISTER
084D  F871                     SHD    LL,WJV1,8              POSITION FIRST DIGIT
084E  A502 2030                IOR    I,WJV2,02030           CONVERT TO ASCII
0850  9C02 0B13                STR    D,WJV2,WJDRF1          STORE IN DISPLAY BUFFER
0852  4002                     LDR    IS,WJV2,0              CLEAR REGISTER
0853  F831                     SHD    LL,WJV1,4              POSITION LAST 2 DIGITS
0854  AE32                     SHS    LL,WJV2,4
0855  F831                     SHD    LL,WJV1,4
0856  A502 3030                IOR    I,WJV2,03030           CONVERT TO ASCII
0858  9C02 0B14                STR    D,WJV2,WJDRF1+1        STORE IN DISPLAY BUFFER
085A  E101 0B0D                LDR    I,WJV1,WJDRF           GET ADDRESS OF BUFFER TO OUTPUT
085C  ED00 0230                BAL    I,RET,OUTPUT           OUTPUT BUFFER
085E  E200 09F1                LDR    D,RET,WJ90R            GET RETURN ADDRESS
0860  BF07                     BRC    R,7,RET                RETURN TO CALLER
                    .
                    .
                    .
                    .*************************************************************************
                    . ROUTINE TO INCREMENT FREQUENCY
                    . WJV1 FREQUENCY IN DISPLAY FORMAT (LOWER)
                    . WJV2 FREQUENCY IN DISPLAY FORMAT (UPPER)
                    . WJV3 FREQUENCY INCREMENT IN DISPLAY FORMAT (LOWER)
                    . WJV4 FREQUENCY INCREMENT IN DISPLAY FORMAT (UPPER)
                    . WJV5 ANSWER FREQUENCY IN DISPLAY FORMAT (LOWER)
                    . WJV6 ANSWER FREQUENCY IN DISPLAY FORMAT (UPPER)
                    .*************************************************************************
```

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IOC   OBJECT CODE    CARD IMAGE                                         CARDNUM
                                                                            691
0861  9C00 09F1  WJ96   STR  D,RET,WJ90R      SAVE RETURN ADDRESS           692
0863  E109 000F         LDR  I,WJV9,000F      SET UP MASK                   693
0865  4005              LDR  IS,WJV5,0        CLEAR REGISTER                694
0866  4006              LDR  IS,WJV6,0        CLEAR REGISTER                695
0867  E017              LDR  R,WJV7,WJV1      DO 1ST DIGIT                  696
0868  E038              LDR  R,WJV8,WJV3                                    697
0869  ED00 08A4         BAL  I,RET,WJ961                                    698
086B  E075              LDR  R,WJV5,WJV7                                    699
086C  E017              LDR  R,WJV7,WJV1      DO 2ND DIGIT                  700
086D  AD37              SHS  RL,WJV7,4                                      701
086E  8087              ADD  R,WJV7,WJV8                                    702
086F  E038              LDR  R,WJV8,WJV3                                    703
0870  AD38              SHS  RL,WJV8,4                                      704
0871  ED00 08A4         BAL  I,RET,WJ961                                    705
0873  AE37              SHS  LL,WJV7,4                                      706
0874  A475              IOR  R,WJV5,WJV7                                    707
0875  E017              LDR  R,WJV7,WJV1      DO 3RD DIGIT                  708
0876  AD77              SHS  RL,WJV7,8                                      709
0877  8087              ADD  R,WJV7,WJV8                                    710
0878  E038              LDR  R,WJV8,WJV3                                    711
0879  AD78              SHS  RL,WJV8,8                                      712
087A  ED00 08A4         BAL  I,RET,WJ961                                    713
087C  AE77              SHS  LL,WJV7,8                                      714
087D  A475              IOR  R,WJV5,WJV7                                    715
087E  E017              LDR  R,WJV7,WJV1      DO 4TH DIGIT                  716
087F  ADB7              SHS  RL,WJV7,12                                     717
0880  8087              ADD  R,WJV7,WJV8                                    718
0881  E038              LDR  R,WJV8,WJV3                                    719
0882  ADB8              SHS  RL,WJV8,12                                     720
0883  ED00 08A4         BAL  I,RET,WJ961                                    721
0885  AEB7              SHS  LL,WJV7,12                                     722
0886  A475              IOR  R,WJV5,WJV7                                    723
0887  E027              LDR  R,WJV7,WJV2      DO 5TH DIGIT                  724
0888  8087              ADD  R,WJV7,WJV8                                    725
0889  E048              LDR  R,WJV8,WJV4                                    726
088A  ED00 08A4         BAL  I,RET,WJ961                                    727
088C  E076              LDR  R,WJV6,WJV7                                    728
088D  E027              LDR  R,WJV7,WJV2      DO 6TH DIGIT                  729
088E  AD37              SHS  RL,WJV7,4                                      730
088F  8087              ADD  R,WJV7,WJV8                                    731
0890  E048              LDR  R,WJV8,WJV4                                    732
0891  AD38              SHS  RL,WJV8,4                                      733
0892  ED00 08A4         BAL  I,RET,WJ961                                    734
0894  AE37              SHS  LL,WJV7,4                                      735
0895  A476              IOR  R,WJV6,WJV7                                    736
0896  E027              LDR  R,WJV7,WJV2      DO 7TH DIGIT                  737
0897  AD77              SHS  RL,WJV7,8                                      738
0898  8087              ADD  R,WJV7,WJV8                                    739
0899  E048              LDR  R,WJV8,WJV4                                    740
089A  AD78              SHS  RL,WJV8,8                                      741
089B  ED00 08A4         BAL  I,RET,WJ961                                    742
089D  AE77              SHS  LL,WJV7,8                                      743
```

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LOC   OBJECT CODE      CARD IMAGE                                                                   CARDNUM
089E  A476                        IOR   R,WJV6,WJV7
089F  AEB8                        SHS   LL,WJV8,12            DO LAST DIGIT
08A0  A486                        IOR   R,WJV6,WJV8
08A1  E200 09F1                   LDR   D,RET,WJ90R           GET RETURN ADDRESS
08A3  BF07                        BRC   R,7,RET               RETURN

08A4  A097            WJ961       AND   R,WJV7,WJV9           CLEAR ALL BUT DIGIT
08A5  A098                        AND   R,WJV8,WJV9           CLEAR ALL BUT DIGIT
08A6  8087                        ADD   R,WJV7,WJV8           ADD DIGITS TOGETHER
08A7  4008                        LDR   IS,WJV8,0             CLEAR REGISTER
08A8  20A7                        CMP   IS,WJV7,10            COMPARE WITH DECIMAL 10
08A9  C104 08AD                   BRCL  LT,WJ962              LESS - NO CARRY
08AB  6F67                        ADD   IS,WJV7,-10           DECREMENT ANSWER BY 10
08AC  4018                        LDR   IS,WJV8,1             CARRY ONE
08AD  BF07            WJ962       BRC   R,7,RET               RETURN TO CALLER
                      .
                      .
                      .
                      .**********************************************************************
                      . SEND START CODE TO RECEIVER
                      . SEND CONTROL WORD TO RECEIVER
                      . SEND END CODE TO RECEIVER
                      .**********************************************************************
                      .
08AE  B60B 09AE       WJS         LLC   D,WJXX,WJCRS          XAR  FOR RCVR CHECK
08E0  B603 09B0                   LLC   D,WJX1,WJCRD1         XAR FOR CONTROL WORD ONE
08E2  B604 09B1                   LLC   D,WJX2,WJCRD2         XAR FOR CONTROL WORD TWO
08E4  B605 09B2                   LLC   D,WJX3,WJCRD3          "    "       "   THREE
08E6  B606 09B3                   LLC   D,WJX4,WJCRD4          "    "       "   FOUR
08B8  B602 09AF                   LLC   D,WJXE,WJCRE          XAR FOR END OF LOAD
08BA  E207 09C8                   LDR   D,WJD1,WJCW1          CONTROL WORD ONE
08BC  E208 09C9                   LDR   D,WJD2,WJCW2          TWO
08BE  E209 09CA                   LDR   D,WJD3,WJCW3          THREE
08C0  E20A 09CB                   LDR   D,WJD4,WJCW4          FOUR
08C2  D937                        ROUT  WJD1,WJX1             SEND DATA WORD 1
08C3  D948                        ROUT  WJD2,WJX2             SEND DATA WORD 2
08C4  D959                        ROUT  WJD3,WJX3             SEND DATA WORD 3
08C5  D96A                        ROUT  WJD4,WJX4             SEND DATA WORD 4
08C6  8CB1            WJS1        RIN   WJV1,WJXX             INPUT RCVR CHECK WORD
08C7  E20F 09F5                   LDR   D,WJLPC,WJLPL         LOAD COUNTER
08C9  601F                        ADD   IS,WJLPC,01           INCREMENT COUNTER
08CA  B10F 0014                   CMP   I,WJLPC,20            COMPARE WITH 32 TIMES
08CC  C103 09A4                   BRCL  GE,WJCKF              BRANCH IF GREATER OR EQUAL
08CE  9C0F 09F5                   STR   D,WJLPC,WJLPL         SAVE COUNT
08D0  9E01 0001                   CMPL  I,WJV1,01             CHECK TO SEE IF READY
08D2  C105 08C6                   BRCL  NE,WJS1               LOOP IF NOT READY
08D4  D921                        ROUT  WJV1,WJXE             SEND TRIGGER
08D5  400F                        LDR   IS,WJLPC,0            ZERO COUNTER
08D6  9C0F 09F5                   STR   D,WJLPC,WJLPL         STORE COUNT
08D8  E20F 09F6                   LDR   D,WJLPC,WJLPK         LOAD WJS COUNTER
08DA  601F                        ADD   IS,WJLPC,01           INCREMENT COUNTER
08DB  B10F 0005                   CMP   I,WJLPC,05            FIVE TIMES THROUGH?
```

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LOC   OBJECT CODE     CARD IMAGE                                                                              CARDNUM
08DD  C103 09A4                 BRCL  GE,WJCKF           YES-EXIT / NO-CONTINUE                                  797
08DF  9C0F 09F6                 STR   D,WJLPC,WJLPK      SAVE COUNT                                              798
                      .                                                                                          799
                      .                                                                                          800
                      .                                                                                          801
                      .                                                                                          802
                      .**************************************************************************************   803
                      . SEND 'START TO SEND' CODE TO RECEIVER                                                    804
                      . GET CONTROL WORD FROM RECEIVER                                                           805
                      . SEND 'END OF SEND' TO RECEIVER                                                           806
                      . CONVERT RECEIVED WORD TO DISPLAY FORMAT                                                   807
                      .**************************************************************************************   808
                      .                                                                                          809
08E1  9C00 09F1       WJR       STR   D,RET,WJ90R        SAVE RETURN ADDRESS                                     810
08E3  E60B 09AE                 LLC   D,WJXX,WJCRS       XAR FOR RECEIVER CHECK                                  811
08E5  B601 09B9                 LLC   D,WJXS,WJRCB       XAR  TO START LOAD/STOP MON CLK                         812
08E7  B603 09B5                 LLC   D,WJX1,WJRCD1      XAR FOR CONTROL WORD ONE                                813
08E9  B604 09B6                 LLC   D,WJX2,WJRCD2      TWO                                                     814
08EB  B605 09B7                 LLC   D,WJX3,WJRCD3      THREE                                                   815
08ED  B606 09B8                 LLC   D,WJX4,WJRCD4      FOUR                                                    816
08EF  B602 09BA                 LLC   D,WJXE,WJRCE       XAR TO END INPUT/START MON CLK                          817
08F1  8CB7            WJR1      RIN   WJD1,WJXX          INPUT CHECK                                             818
08F2  E20F 09F5                 LDR   D,WJLPC,WJLPL      LOAD COUNTER                                            819
08F4  601F                      ADD   IS,WJLPC,01        INCREMENT COUNTER                                       820
08F5  B10F 0014                 CMP   I,WJLPC,20         COMPARE WITH 32 TIMES                                   821
08F7  C103 09A4                 BRCL  GE,WJCKF           BRANCH IF GREATER OR EQUAL                              822
08F9  9C0F 09F5                 STR   D,WJLPC,WJLPL      SAVE COUNT                                              823
08FB  9E07 0001                 CMPL  I,WJD1,01          CHECK TO SEE IF READY                                   824
08FD  C105 08F1                 BRCL  NE,WJR1            LOOP IF NOT READY                                       825
08FF  D917                      ROUT  WJD1,WJXS          STOP MONITOR CLOCK                                      826
0900  8C37                      RIN   WJD1,WJX1          INPUT FIRST CONTROL WORD                                827
0901  8C48                      RIN   WJD2,WJX2          SECOND                                                  828
0902  8C59                      RIN   WJD3,WJX3          THIRD                                                   829
0903  8C6A                      RIN   WJD4,WJX4          FOURTH                                                  830
0904  D927                      ROUT   WJD1,WJXE         START MONITOR CLOCK                                     831
0905  9C37 09CC                 STRM  D,WJD1,WJRS1,4     STORE RECEIVED DATA WORDS                               832
0907  E201 09F4                 LDR   D,WJV1,CHKPLG1     LOAD REG 1 FOR CHECK                                    833
0909  9E01 0001                 CMPL  I,WJV1,01          CHECK FOR COMMAND 6                                     834
090B  C102 0921                 BRCL  EQ,WJR2            COMMAND 6=BRANCH                                        835
090D  E204 09C8                 LDR   D,WJV4,WJCW1       CONTROL WORD ONE                                        836
090F  E205 09C9                 LDR   D,WJV5,WJCW2       TWO                                                     837
0911  E206 09CA                 LDR   D,WJV6,WJCW3       THREE                                                   838
0913  B047                      CMP   R,WJD1,WJV4        COMPARE SENT AND RECEIVED WORDS 1                       839
0914  C105 08AE                 BRCL  NE,WJS             NOT THE SAME-SEND AGAIN                                 840
0916  B058                      CMP   R,WJD2,WJV5        COMPARE 2                                               841
0917  C105 08AE                 BRCL  NE,WJS             NOT THE SAME-SEND AGAIN                                 842
0919  B069                      CMP   R,WJD3,WJV6        COMPARE 3                                               843
091A  C105 08AE                 BRCL  NE,WJS             NOT THE SAME-SEND AGAIN                                 844
091C  400F                      LDR   IS,WJLPC,0         ZERO COUNTER                                            845
091D  9C0F 09F5                 STR   D,WJLPC,WJLPL      STORE COUNT                                             846
091F  9C0F 09F6                 STR   D,WJLPC,WJLPK      SAVE COUNT                                              847
0921  E202 09CC       WJR2      LDR   D,WJV2,WJRS1       GET FREQUENCY UPPER                                     848
0923  E201 09CD                 LDR   D,WJV1,WJRS2       GET FREQUENCY LOWER                                     849
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LOC   OBJECT CODE    CARD IMAGE                                                          CARDNUM
0925  B831           SHD  RL,WJV1,4          POSITION FREQUENCY FOR DISPLAY                 850
0926  A102 03FF      AND  I,WJV2,03FF        CLEAR ALL BUT FREQUENCY                        851
0928  9C01 09E0      STR  D,WJV1,WJRFL       STORE IN RECEIVED DISPLAY (LOWER)              852
092A  9C02 09E1      STR  D,WJV2,WJRFU       STORE IN RECEIVED DISPLAY (UPPER)              853
092C  E201 09CD      LDR  D,WJV1,WJRS2       GET RECEIVED WORD 2                            854
092E  A101 000C      AND  I,WJV1,0C          CLEAR ALL BUT GAIN MODE                        855
0930  AD11           SHS  RL,WJV1,2          POSITION GAIN MODE                             856
0931  9C01 09E5      STR  D,WJV1,WJRGM       STORE IN RECEIVED GAIN MODE FOR DISP           857
0933  E201 09CE      LDR  D,WJV1,WJRS3       GET RECEIVED WORD 3                            858
0935  E202 09CD      LDR  D,WJV2,WJRS2       GET RECEIVED WORD 2                            859
0937  F801           SHD  LL,WJV1,1          POSITION RECEIVED BANDWIDTH                    860
0938  A102 0007      AND  I,WJV2,07          CLEAR ALL BUT BANDWIDTH                        861
093A  9C02 09E7      STR  D,WJV2,WJRIF       STORE IN RECEIVED DISPLAY                      862
093C  A101 E000      AND  I,WJV1,0E000       CLEAR ALL BUT DETECT MODE                      863
093E  ADC1           SHS  RL,WJV1,13         POSITION DETECT MODE                           864
093F  9C01 09E2      STR  D,WJV1,WJRDM       STORE IN RECEIVED DISPLAY                      865
0941  E101 0004      LDR  I,WJV1,04          GET BFO UPPER DISPLAY                          866
0943  9C01 09E4      STR  D,WJV1,WJRBU       STORE IN RECEIVED DISPLAY                      867
0945  E201 09CE      LDR  D,WJV1,WJRS3       GET RECEIVED BFO FREQUENCY                     868
0947  A101 07FF      AND  I,WJV1,07FF        CLEAR ALL BUT BFO FREQUENCY                    869
0949  4002           LDR  IS,WJV2,0          CLEAR REG 2                                    870
094A  CD01 07D0      MUL  I,WJV1,07D0        MULTIPLY BY 2000                               871
094C  E103 07FF      LDR  I,WJV3,07FF        LOAD DIVISOR                                   872
094E  8101 0400      ADD  I,WJV1,0400        ROUND                                          873
0950  FC31           DIV  R,WJV1,WJV3        DIVIDE                                         874
0951  8102 1194      ADD  I,WJV2,01194       ADD 4500                                       875
0953  4003           LDR  IS,WJV3,0          CLEAR REG 3                                    876
0954  40A4           LDR  IS,WJV4,10         SET UP DIVISOR                                 877
0955  FC42           DIV  R,WJV2,WJV4        DIVIDE BY 10                                   878
0956  E021           LDR  R,WJV1,WJV2        PUT REMAINDER IN WJV1 AS 1ST DIGIT             879
0957  E032           LDR  R,WJV2,WJV3        GET QUOTIENT                                   880
0958  4003           LDR  IS,WJV3,0          CLEAR REGISTER                                 881
0959  FC42           DIV  R,WJV2,WJV4        DIVIDE BY 10                                   882
095A  AE32           SHS  LL,WJV2,4          POSITION 2ND DIGIT                             883
095B  A421           IOR  R,WJV1,WJV2        PUT 2ND DIGIT IN ANSWER                        884
095C  E032           LDR  R,WJV2,WJV3        GET QUOTIENT                                   885
095D  4003           LDR  IS,WJV3,0          CLEAR REGISTER                                 886
095E  FC42           DIV  R,WJV2,WJV4        DIVIDE BY 10                                   887
095F  AE72           SHS  LL,WJV2,8          POSITION 3RD DIGIT                             888
0960  AEB3           SHS  LL,WJV3,12         POSITION 4TH DIGIT                             889
0961  A421           IOR  R,WJV1,WJV2        PUT IN 3RD DIGIT                               890
0962  A431           IOR  R,WJV1,WJV3        PUT IN 4TH DIGIT                               891
0963  9C01 09E3      STR  D,WJV1,WJRBL       STORE IN RECEIVED BFO FREQ DISPLAY (           892
0965  E202 09CF      LDR  D,WJV2,WJRS4       GET RECEIVED WORD 4                            893
0967  A102 7F00      AND  I,WJV2,07F00       CLEAR ALL BUT RF GAIN                          894
0969  AD72           SHS  RL,WJV2,8          RIGHT JUSTIFY                                  895
096A  B421           LLC  R,WJV1,WJV2        COMPLEMENT                                     896
096B  A101 007F      AND  I,WJV1,07F         CLEAR ALL BUT RF GAIN                          897
096D  ED00 097C      BAL  I,RET,WJR3         CONVERT TO BCD PERCENTAGE                      898
096F  9C01 09E6      STR  D,WJV1,WJRRFG      STORE IN RECEIVED DISPLAY                      899
0971  E201 09CF      LDR  D,WJV1,WJRS4       GET RECEIVED WORD 4                            900
0973  A101 007F      AND  I,WJV1,07F         CLEAR ALL BUT SIGNAL STRENGTH                  901
0975  ED00 097C      BAL  I,RET,WJR3         CONVERT TO BCD PERCENTAGE                      902
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LOC   OBJECT CODE      CARD IMAGE                                                                        CARDNUM
0977  9C01 09E9                 STR   D,WJV1,WJRSS       STORE IN RECEIVED DISPLAY                          903
0979  E200 09F1                 LDR   D,RET,WJ90R        GET RETURN ADDRESS                                 904
097B  BF07                      BRC   R,7,RET            RETURN TO CALLER                                   905
                                                                                                            906
097C  CD01 0064        WJR3     MUL   I,WJV1,064         MULTIPLY BY 100                                    907
097E  6371                      ADD   IS,WJV1,037        ROUND                                              908
097F  47F3                      LDR   IS,WJV3,07F        SET UP DIVISOR                                     909
0980  FC31                      DIV   R,WJV1,WJV3        DIVIDE BY 127                                      910
0981  E021                      LDR   R,WJV1,WJV2        PUT DIVIDEND IN REG 1                              911
0982  4002                      LDR   IS,WJV2,0          CLEAR REGISTER                                     912
0983  40A3                      LDR   IS,WJV3,10         SET UP DIVISOR                                     913
0984  FC31                      DIV   R,WJV1,WJV3        DIVIDE BY 10                                       914
0985  E014                      LDR   R,WJV4,WJV1        PUT REMAINDER IN REG 4 (DIGIT 1)                   915
0986  E021                      LDR   R,WJV1,WJV2        SET UP DIVIDEND                                    916
0987  4002                      LDR   IS,WJV2,0          CLEAR REGISTER                                     917
0988  FC31                      DIV   R,WJV1,WJV3        DIVIDE BY 10                                       918
0989  AE31                      SHS   LL,WJV1,4          POSITION 2ND DIGIT                                 919
098A  AE72                      SHS   LL,WJV2,8          POSITION 3RD DIGIT                                 920
098B  A441                      IOR   R,WJV1,WJV4        COMBINE 1ST AND 2ND DIGITS                         921
098C  A421                      IOR   R,WJV1,WJV2        COMBINE ALL DIGITS                                 922
098D  BF07                      BRC   R,7,RET            RETURN TO CALLER                                   923
                       .                                                                                    924
                       .                                                                                    925
                       .                                                                                    926
                       .                                                                                    927
                       .*****************************************************************                   928
                       . BCD TO HEX ROUTINE (4 DIGIT BCD VALUE)                                             929
                       . BCD VALUE PASSED IN WJV2                                                           930
                       . HEX VALUE RETURNED IN WJV1                                                         931
                       . ROUTINE USES WJV1,WJV2,WJV3,WJV4                                                   932
                       .*****************************************************************                   933
                                                                                                            934
098E  E021             WJBCDH   LDR   R,WJV1,WJV2        LOAD LEAST SIGNIFICANT BITS, PART 1                935
098F  A101 000F                 AND   I,WJV1,0F            "     "        "       "  , PART 2               936
0991  AD32                      SHS   RL,WJV2,4          SHIFT FOR MULTIPLICATION                           937
0992  E023                      LDR   R,WJV3,WJV2        LOAD DUMMY REG FOR MULTIPLICATION                  938
0993  A103 000F                 AND   I,WJV3,15          CLEAR ALL BUT LEAST SIG BITS                       939
0995  CD03 000A                 MUL   I,WJV3,10          MULTIPLY BY 16                                     940
0997  8031                      ADD   R,WJV1,WJV3        ADD ONTO ANSWER                                    941
0998  AD32                      SHS   RL,WJV2,4          SHIFT FOR MULTIPLICATION                           942
0999  E023                      LDR   R,WJV3,WJV2        LOAD DUMMY REG FOR MULTIPLICATION                  943
099A  A103 000F                 AND   I,WJV3,15          CLEAR ALL BUT LEAST SIG BITS                       944
099C  CD03 0064                 MUL   I,WJV3,064         MULTIPLY BY 100                                    945
099E  8031                      ADD   R,WJV1,WJV3        ADD ONTO ANSWER                                    946
099F  AD32                      SHS   RL,WJV2,4          SHIFT FOR MULTIPLICATION                           947
09A0  CD02 03E8                 MUL   I,WJV2,03E8        MULTIPLY BY 1000                                   948
09A2  8021                      ADD   R,WJV1,WJV2        ADD ONTO ANSWER                                    949
09A3  BF07                      BRC   R,7,RET            RETURN TO CALLER                                   950
                       .                                                                                    951
                       .                                                                                    952
                       .                                                                                    953
                                PAGE                                                                        954
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LOC   OBJECT CODE     CARD IMAGE                                                                         CARDNUM
                                                                                                           955
                     . ******************************                                                      956
                     .  ROUTINE TO OUTPUT LOOP MESSAGE                                                     957
                     . ******************************                                                      958
09A4  E101 0BD2      WJCKP     LDR    I,WJV1,WJCP          LOAD ADDRESS OF OUTPUT                          959
09A6  400F                     LDR    IS,WJLPC,0           ZERO COUNTER                                    960
09A7  9C0F 09F6                STR    D,WJLPC,WJLPK        SAVE ZERO COUNT                                 961
09A9  ED00 0230                BAL    I,RET,OUTPUT         OUTPUT LOOP BUFFER                              962
09AB  C107 0519                BRCL   U,WJ02               RETURN TO RECEIVER CONTROL                      963
                     .                                                                                     964
                     .                                                                                     965
                     .                                                                                     966
                     .                                                                                     967
                     .****************************************************************                     968
                     . DATA BUFFERS                                                                        969
                     .****************************************************************                     970
                     .                                                                                     971
                     . RETURN ADDRESS                                                                      972
09AD                 WJRET     DS     1                    SAVE RETURN ADDRESS                             973
                     .                                                                                     974
                     . XAR ADDRESSES                                                                       975
09AE  2300           WJCRS     DC     02300                XAR TO DETERMINE IF RECEIVER IS READY           976
09AF  2000           WJCRE     DC     02000                XAR FOR COMPLETION OF SEND/TRIGGER              977
09B0  2010           WJCRD1    DC     02010                XAR OUTPUT CONTROL WORD ONE                     978
09B1  2020           WJCRD2    DC     02020                XAR OUT TWO                                     979
09B2  2030           WJCRD3    DC     02030                XAR OUT THREE                                   980
09B3  2100           WJCRD4    DC     02100                XAR OUT FOUR                                    981
09B4  2330           WJCRF     DC     02330                DISABLE RECEIVER                                982
09B5  2230           WJRCD1    DC     02230                XAR INPUT CONTRCL WORD ONE                      983
09B6  2220           WJRCD2    DC     02220                XAR IN TWO                                      984
09B7  2210           WJRCD3    DC     02210                XAR IN THREE                                    985
09B8  2200           WJRCD4    DC     02200                XAR IN FOUR                                     986
09B9  2110           WJRCB     DC     02110                XAR TO START INPUT/STOP MONITOR CLOCK           987
09BA  2120           WJRCE     DC     02120                XAR END INPUT/START MONITOR CLOCK               988
09BB  2130           WJCRO     DC     02130                ENABLE RECEIVER XAR                             989
                     .                                                                                     990
                     . INITIAL CONTROL WORD                                                                991
09BC  0055           WJI1      DC     00055                INITIAL CONTROL WORD 1                          992
09BD  000A           WJI2      DC     0000A                INITIAL CONTROL WORD 2                          993
09BE  0400           WJI3      DC     00400                INITIAL CONTROL WORD 3                          994
09EF  0000           WJI4      DC     00000                INITIAL CONTROL WORD 4                          995
                     .                                                                                     996
                     . INITIAL CONTROL WORD - DISPLAY FORMAT                                               997
09C0  5000           WJICD     DC     05000                CONTROL FREQUENCY (LOWER)                       998
09C1  0005                     DC     00005                CONTROL FREQUENCY (UPPER)                       999
09C2  0000                     DC     0                    CONTROL DETECT MODE                            1000
09C3  5500                     DC     05500                CONTROL BFO FREQUENCY (LOWER)                  1001
09C4  0004                     DC     04                   CONTROL BFO FREQUENCY (UPPER)                  1002
09C5  0002                     DC     00002                CONTROL GAIN MODE                              1003
09C6  0100                     DC     0100                 CONTROL RF GAIN                                1004
09C7  0004                     DC     04                   CONTROL IF BANDWIDTH                           1005
                     .                                                                                    1006
                     . CONTRCI WORD                                                                       1007
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LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
09C8                  WJCW1    DS    1              RCVR CONTROL WORD 1             1008
09C9                  WJCW2    DS    1                                2             1009
09CA                  WJCW3    DS    1                                3             1010
09CB                  WJCW4    DS    1                                4             1011
                      .                                                             1012
                      . RECEIVED WORD FROM WJ                                       1013
09CC                  WJRS1    DS    1              RCVR SENT WORD 1                1014
09CD                  WJRS2    DS    1                             2                1015
09CE                  WJRS3    DS    1                             3                1016
09CF                  WJRS4    DS    1                             4                1017
                      .                                                             1018
                      . TENTATIVE VALUES - DISPLAY FORMAT                           1019
09D0                  WJTFL    DS    1              TENTATIVE FREQ(LOWER)           1020
09D1                  WJTFU    DS    1              TENTATIVE FREQ(UPPER)           1021
09D2                  WJTDM    DS    1              TENTATIVE DETECT MODE           1022
09D3                  WJTBL    DS    1              TENTATIVE BFO FREQ(LOWER)       1023
09D4                  WJTBU    DS    1              TENTATIVE BFO FREQ (UPPER)      1024
09D5                  WJTGM    DS    1              TENTATIVE GAIN MODE             1025
09D6                  WJTRFG   DS    1              TENTATIVE RF GAIN               1026
09D7                  WJTIF    DS    1              TENTATIVE IF BANDWIDTH          1027
                      .                                                             1028
                      . CONTROL VALUES - DISPLAY FORMAT                             1029
09D8                  WJCFL    DS    1              CONTROL FREQUENCY (LOWER)       1030
09D9                  WJCFU    DS    1              CONTROL FREQUENCY (UPPER)       1031
09DA                  WJCDM    DS    1              CONTROL DETECT MODE             1032
09DB                  WJCBL    DS    1              CONTROL BFO FREQUENCY (LOWER)   1033
09DC                  WJCBU    DS    1              CONTROL BFO FREQUENCY (UPPER)   1034
09DD                  WJCGM    DS    1              CONTROL GAIN MODE               1035
09DE                  WJCRFG   DS    1              CONTROL RF GAIN                 1036
09DF                  WJCIF    DS    1              CONTROL IF BANDWIDTH            1037
                      .                                                             1038
                      . RECEIVED VALUES - DISPLAY FORMAT                            1039
09E0                  WJRFL    DS    1              RECEIVED FREQUENCY (LOWER)      1040
09E1                  WJRFU    DS    1              RECEIVED FREQUENCY (UPPER)      1041
09E2                  WJRDM    DS    1              RECEIVED DETECT MODE            1042
09E3                  WJRBL    DS    1              RECEIVED BFO FREQUENCY (LOWER)  1043
09E4                  WJRBU    DS    1              RECEIVED BFO FREQUENCY (UPPER)  1044
09E5                  WJRGM    DS    1              RECEIVED GAIN MODE              1045
09E6                  WJRRFG   DS    1              RECEIVED RF GAIN                1046
09E7                  WJRIF    DS    2              RECEIVED IF BANDWIDTH           1047
09E9                  WJRSS    DS    1              RECEIVED SIGNAL STRENGTH        1048
                      .                                                             1049
                      .                                                             1050
                      . SCAN VARIABLES                                              1051
09EA                  WJSFUU   DS    1              UPPER LIMIT (UPPER)             1052
09EB                  WJSFUL   DS    1              UPPER LIMIT (LOWER)             1053
09EC                  WJSFLU   DS    1              LOWER LIMIT (UPPER)             1054
09ED                  WJSFLL   DS    1              LOWER LIMIT (LOWER)             1055
09EE                  WJSFIN   DS    1              FREQUENCY INCREMENT (8 KHZ MAX) 1056
09EF                  WJSFSS   DS    1              SIGNAL STRENGTH                 1057
09F0                  WJSCNT   DS    1              COUNT OF NUMBER OF SCAN PASSES  1058
                      .                                                             1059
                      . SAVE LOCATIONS FOR ALL WJ9- ROUTINES                        1060
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LOC   OBJECT CODE     CARD IMAGE                                                  CARDNUM
09F1                  WJ90R     DS    1                                            1061
09F2                  WJ90S1    DS    1                                            1062
09F3                  WJ90S2    DS    1                                            1063
09F4                  CHKFIG1   DS    1         FLAG FOR COMMAND 6                 1064
09F5                  WJLPL     DS    1         LOOP COUNTER STORAGE               1065
09F6                  WJLPK     DS    1         WJS COUNTER STORAGE                1066
                      .                                                            1067
                      . RECEIVER CONTROL TITLE BUFFER                              1068
09F7  0009            WJT       DC    9         RECEIVER CONTROL TITLE             1069
09F8  0D0A                      DC    00D0A     CR/LF                              1070
09F9  5245                      DC    05245     RE                                 1071
09FA  4345                      DC    04345     CE                                 1072
09FB  4956                      DC    04956     IV                                 1073
09FC  4552                      DC    04552     ER                                 1074
09FD  2043                      DC    02043      C                                 1075
09FE  4F4E                      DC    04F4E     ON                                 1076
09FF  5452                      DC    05452     TR                                 1077
0A00  4F4C                      DC    04F4C     OL                                 1078
0A01  0000                      DC    0         NULL                               1079
                      .                                                            1080
                      .                                                            1081
                      . COMMANDS BUFFER                                            1082
0A02  0047            WJINS     DC    71                                           1083
0A03  303D                      DC    0303D     0=                                 1084
0A04  5345                      DC    05345     SE                                 1085
0A05  542D                      DC    0542D     T-                                 1086
0A06  5550                      DC    05550     UP                                 1087
0A07  0D0A                      DC    00D0A     CR/LF                              1088
0A08  313D                      DC    0313D     1=                                 1089
0A09  4449                      DC    04449     DI                                 1090
0A0A  5350                      DC    05350     SP                                 1091
0A0B  4C41                      DC    04C41     LA                                 1092
0A0C  5920                      DC    05920     Y                                  1093
0A0D  5445                      DC    05445     TE                                 1094
0A0E  4E54                      DC    04E54     NT                                 1095
0A0F  4154                      DC    04154     AT                                 1096
0A10  4956                      DC    04956     IV                                 1097
0A11  450D                      DC    0450D     E/CR                               1098
0A12  0A32                      DC    00A32     LF/2                               1099
0A13  3D44                      DC    03D44     =D                                 1100
0A14  4953                      DC    04953     IS                                 1101
0A15  504C                      DC    0504C     PL                                 1102
0A16  4159                      DC    04159     AY                                 1103
0A17  2043                      DC    02043      C                                 1104
0A18  4F4E                      DC    04F4E     ON                                 1105
0A19  5452                      DC    05452     TR                                 1106
0A1A  4F4C                      DC    04F4C     OL                                 1107
0A1B  0D0A                      DC    00D0A     CR/LF                              1108
0A1C  333D                      DC    0333D     3=                                 1109
0A1D  4449                      DC    04449     DI                                 1110
0A1E  5350                      DC    05350     SP                                 1111
0A1F  4C41                      DC    04C41     LA                                 1112
0A20  5920                      DC    05920     Y                                  1113
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LOC   OBJECT CODE    CARD IMAGE                                   CARDNUM
0A21  5245                    DC   05245         RE                1114
0A22  4345                    DC   04345         CE                1115
0A23  4956                    DC   04956         IV                1116
0A24  4544                    DC   04544         ED                1117
0A25  0D0A                    DC   00D0A         CR/LF             1118
0A26  343D                    DC   0343D         4=                1119
0A27  454E                    DC   0454E         EN                1120
0A28  5445                    DC   05445         TE                1121
0A29  5220                    DC   05220         R                 1122
0A2A  5445                    DC   05445         TE                1123
0A2B  4E54                    DC   04E54         NT                1124
0A2C  4154                    DC   04154         AT                1125
0A2D  4956                    DC   04956         IV                1126
0A2E  450D                    DC   0450D         E/CR              1127
0A2F  0A35                    DC   00A35         LF/5              1128
0A30  3D53                    DC   03D53         =S                1129
0A31  4341                    DC   04341         CA                1130
0A32  4E20                    DC   04E20         N                 1131
0A33  0D0A                    DC   00D0A         CR/LF             1132
0A34  363D                    DC   0363D         6=                1133
0A35  5245                    DC   05245         RE                1134
0A36  4345                    DC   04345         CE                1135
0A37  4956                    DC   04956         IV                1136
0A38  4520                    DC   04520         E                 1137
0A39  434F                    DC   0434F         CO                1138
0A3A  4E54                    DC   04E54         NT                1139
0A3B  524F                    DC   0524F         RO                1140
0A3C  4C20                    DC   04C20         L                 1141
0A3D  0D0A                    DC   00D0A         CR/LF             1142
0A3E  373D                    DC   0373D         7=                1143
0A3F  444F                    DC   0444F         DO                1144
0A40  4E45                    DC   04E45         NE                1145
0A41  0D0A                    DC   00D0A         CR/LF             1146
0A42  383D                    DC   0383D         8=                1147
0A43  5245                    DC   05245         RE                1148
0A44  494E                    DC   0494E         IN                1149
0A45  4954                    DC   04954         IT                1150
0A46  494C                    DC   0494C         IL                1151
0A47  495A                    DC   0495A         IZ                1152
0A48  4520                    DC   04520         E                 1153
0A49  0D0A                    DC   00D0A         CR/LF             1154
0A4A  0000                    DC   0             NULL              1155
                     .                                             1156
                     . FREQUENCY TITLE BUFFER                      1157
0A4B  0006           WJFB     DC   6             COUNT             1158
0A4C  4652                    DC   04652         FR                1159
0A4D  4551                    DC   04551         EQ                1160
0A4E  2028                    DC   02028          (                1161
0A4F  485A                    DC   0485A         HZ                1162
0A50  2920                    DC   02920         )                 1163
0A51  0D0A                    DC   00D0A         CR/LF             1164
0A52  0000                    DC   0             NULL              1165
                     .                                             1166
```

```
LOC   OBJECT CODE      CARD IMAGE                                          CARDNUM
                       . GAIN MODE TITLE BUFFER                               1167
0A53  0018             WJGMB    DC    24          COUNT                       1168
0A54  4741                      DC    04741       GA                          1169
0A55  494E                      DC    0494E       IN                          1170
0A56  204D                      DC    0204D        M                          1171
0A57  4F44                      DC    04F44       OD                          1172
0A58  450D                      DC    0450D       ECR                         1173
0A59  0A30                      DC    00A30       LF0                         1174
0A5A  3D48                      DC    03D48       =H                          1175
0A5B  4F4C                      DC    04F4C       OL                          1176
0A5C  4420                      DC    04420       D                           1177
0A5D  4147                      DC    04147       AG                          1178
0A5E  430D                      DC    0430D       CCR                         1179
0A5F  0A32                      DC    00A32       LF2                         1180
0A60  3D4E                      DC    03D4E       =N                          1181
0A61  4F52                      DC    04F52       OR                          1182
0A62  4D41                      DC    04D41       MA                          1183
0A63  4C20                      DC    04C20       L                           1184
0A64  4147                      DC    04147       AG                          1185
0A65  430D                      DC    0430D       CCR                         1186
0A66  0A33                      DC    00A33       LF3                         1187
0A67  3D4D                      DC    03D4D       =M                          1188
0A68  414E                      DC    0414E       AN                          1189
0A69  5541                      DC    05541       UA                          1190
0A6A  4C20                      DC    04C20       L                           1191
0A6B  0D0A                      DC    00D0A       CR/LF                       1192
0A6C  0000                      DC    0           NULL                        1193
                       .                                                      1194
                       . IF BANDWIDTH TITLE BUFFER                            1195
0A6D  001A             WJIFB    DC    26          COUNT                       1196
0A6E  4946                      DC    04946       IF                          1197
0A6F  2042                      DC    02042        B                          1198
0A70  414E                      DC    0414E       AN                          1199
0A71  4457                      DC    04457       DW                          1200
0A72  4944                      DC    04944       ID                          1201
0A73  5448                      DC    05448       TH                          1202
0A74  0D0A                      DC    00D0A       CR/LF                       1203
0A75  313D                      DC    0313D       1=                          1204
0A76  3530                      DC    03530       50                          1205
0A77  3020                      DC    03020       0                           1206
0A78  485A                      DC    0485A       HZ                          1207
0A79  0D0A                      DC    00D0A       CR/LF                       1208
0A7A  323D                      DC    0323D       2=                          1209
0A7B  3220                      DC    03220       2                           1210
0A7C  4B48                      DC    04B48       KH                          1211
0A7D  5A0D                      DC    05A0D       ZCR                         1212
0A7E  0A33                      DC    00A33       LF3                         1213
0A7F  3D34                      DC    03D34       =4                          1214
0A80  204B                      DC    0204B        K                          1215
0A81  485A                      DC    0485A       HZ                          1216
0A82  0D0A                      DC    00D0A       CR/LF                       1217
0A83  343D                      DC    0343D       4=                          1218
0A84  3820                      DC    03820       8                           1219
```

```
LOC   OBJECT CODE      CARD IMAGE                                          CARDNUM
0A85  4B48                        DC      04B48           KH                  1220
0A86  5A20                        DC      05A20           Z                   1221
0A87  0D0A                        DC      00D0A           CR/LF               1222
0A88  0000                        DC      0               NULL                1223
                       *                                                      1224
                       . DETECT MODE TITLE BUFFER                             1225
0A89  0028             WJDMB      DC      40              COUNT               1226
0A8A  4445                        DC      04445           DE                  1227
0A8B  5445                        DC      05445           TE                  1228
0A8C  4354                        DC      04354           CT                  1229
0A8D  204D                        DC      0204D            M                  1230
0A8E  4F44                        DC      04F44           OD                  1231
0A8F  450D                        DC      0450D           ECR                 1232
0A90  0A30                        DC      00A30           LF0                 1233
0A91  3D41                        DC      03D41           =A                  1234
0A92  4D0D                        DC      04D0D           MCR                 1235
0A93  0A31                        DC      00A31           LF1                 1236
0A94  3D46                        DC      03D46           =F                  1237
0A95  4D0D                        DC      04D0D           MCR                 1238
0A96  0A32                        DC      00A32           LF2                 1239
0A97  3D42                        DC      03D42           =B                  1240
0A98  464F                        DC      0464F           FO                  1241
0A99  2046                        DC      02046            F                  1242
0A9A  4958                        DC      04958           IX                  1243
0A9B  4544                        DC      04544           ED                  1244
0A9C  0D0A                        DC      00D0A           CR/LF               1245
0A9D  333D                        DC      0333D           3=                  1246
0A9E  4246                        DC      04246           BF                  1247
0A9F  4F20                        DC      04F20           O                   1248
0AA0  5641                        DC      05641           VA                  1249
0AA1  520D                        DC      0520D           RCR                 1250
0AA2  0A34                        DC      00A34           LF4                 1251
0AA3  3D49                        DC      03D49           =I                  1252
0AA4  5342                        DC      05342           SB                  1253
0AA5  0D0A                        DC      00D0A           CR/LF               1254
0AA6  353D                        DC      0353D           5=                  1255
0AA7  4C53                        DC      04C53           LS                  1256
0AA8  420D                        DC      0420D           BCR                 1257
0AA9  0A36                        DC      00A36           LF6                 1258
0AAA  3D55                        DC      03D55           =U                  1259
0AAB  5342                        DC      05342           SB                  1260
0AAC  0D0A                        DC      00D0A           CR/LF               1261
0AAD  373D                        DC      0373D           7=                  1262
0AAE  414D                        DC      0414D           AM                  1263
0AAF  2D4E                        DC      02D4E           -N                  1264
0AB0  4C20                        DC      04C20           L                   1265
0AB1  0D0A                        DC      00D0A           CR/LF               1266
0AB2  0000                        DC      0               NULL                1267
                       *                                                      1268
                       . BFO FREQUENCY TITLE BUFFER                           1269
0AB3  0015             WJBFB      DC      21              COUNT               1270
0AB4  4246                        DC      04246           BF                  1271
0AB5  4F20                        DC      04F20           O                   1272
```

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ATAC                                                                TIME: 16:43:42     03/18/77     PAGE    25
LOC    OBJECT CODE      CARD IMAGE                                                                  CARDNUM
0AB6   4652                       DC     04652          FR                                             1273
0AB7   4551                       DC     04551          EQ                                             1274
0AB8   2028                       DC     02028           (                                             1275
0AB9   485A                       DC     0485A          HZ                                             1276
0ABA   2920                       DC     02920          )                                              1277
0ABB   0D0A                       DC     00D0A          CR/LF                                          1278
0ABC   3434                       DC     03434          44                                             1279
0ABD   3520                       DC     03520          5                                              1280
0ABE   4B48                       DC     04B48          KH                                             1281
0ABF   5A20                       DC     05A20          Z                                              1282
0AC0   544F                       DC     0544F          TO                                             1283
0AC1   2034                       DC     02034           4                                             1284
0AC2   3635                       DC     03635          65                                             1285
0AC3   204B                       DC     0204B           K                                             1286
0AC4   485A                       DC     0485A          HZ                                             1287
0AC5   2049                       DC     02049           I                                             1288
0AC6   4E20                       DC     04E20          N                                              1289
0AC7   485A                       DC     0485A          HZ                                             1290
0AC8   0D0A                       DC     00D0A          CR/LF                                          1291
0AC9   0000                       DC     0              NULL                                           1292
                         :                                                                             1293
                         :RF GAIN TITLE BUFFER                                                         1294
0ACA   000C              WJRFGB   DC     12             COUNT                                          1295
0ACB   5246                       DC     05246          RF                                             1296
0ACC   2047                       DC     02047           G                                             1297
0ACD   4149                       DC     04149          AI                                             1298
0ACE   4E0D                       DC     04E0D          NCR                                            1299
0ACF   0A28                       DC     00A28          LF(                                            1300
0AD0   5045                       DC     05045          PE                                             1301
0AD1   5243                       DC     05243          RC                                             1302
0AD2   454E                       DC     0454E          EN                                             1303
0AD3   5441                       DC     05441          TA                                             1304
0AD4   4745                       DC     04745          GE                                             1305
0AD5   2920                       DC     02920          )                                              1306
0AD6   0D0A                       DC     00D0A          CR/LF                                          1307
0AD7   0000                       DC     0              NULL                                           1308
                         :                                                                             1309
                         : FREQUENCY TITLE FOR DISPLAY                                                 1310
0AD8   000B              WJDF     DC     11             COUNT                                          1311
0AD9   4652                       DC     04652          FR                                             1312
0ADA   4551                       DC     04551          EQ                                             1313
0ADB   203D                       DC     0203D           =                                             1314
0ADC   2020                       DC     02020                                                         1315
0ADD   2020              WJDF1    DC     02020          XX                                             1316
0ADE   2020                       DC     02020          XX                                             1317
0ADF   2020                       DC     02020          XX                                             1318
0AE0   2020                       DC     02020          XX                                             1319
0AE1   2048                       DC     02048           H                                             1320
0AE2   5A20                       DC     05A20          Z                                              1321
0AE3   0D0A                       DC     00D0A          CR/LF                                          1322
0AE4   0000                       DC     0              NULL                                           1323
                         :                                                                             1324
                         : DETECT MODE TITLE FOR DISPLAY                                               1325
```

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LOC   OBJECT CODE     CARD IMAGE                                          CARDNUM
0AE5  0007          WJDDM     DC    7           COUNT                     1326
0AE6  4445                    DC    04445       DE                        1327
0AE7  5445                    DC    05445       TE                        1328
0AE8  4354                    DC    04354       CT                        1329
0AE9  204D                    DC    0204D        M                        1330
0AEA  4F44                    DC    04F44       OD                        1331
0AEB  4520                    DC    04520       E                         1332
0AEC  3D20                    DC    03D20       =                         1333
0AED  0000                    DC    0           NULL                      1334
                    .                                                     1335
                    . BFO FREQUENCY TITLE FOR DISPLAY                     1336
0AEE  000B          WJDBF     DC    11          COUNT                     1337
0AEF  4246                    DC    04246       BF                        1338
0AF0  4F20                    DC    04F20       O                         1339
0AF1  4652                    DC    04652       FR                        1340
0AF2  4551                    DC    04551       EQ                        1341
0AF3  203D                    DC    0203D        =                        1342
0AF4  2034                    DC    02034        4                        1343
0AF5  2020          WJDBF1    DC    02020       XX                        1344
0AF6  2020                    DC    02020       XX                        1345
0AF7  3020                    DC    03020       0                         1346
0AF8  485A                    DC    0485A       HZ                        1347
0AF9  0D0A                    DC    00D0A       CR/LF                     1348
0AFA  0000                    DC    0           NULL                      1349
                    .                                                     1350
                    . GAIN MODE TITLE FOR DISPLAY                         1351
0AFB  0006          WJDGM     DC    6           COUNT                     1352
0AFC  4741                    DC    04741       GA                        1353
0AFD  494E                    DC    0494E       IN                        1354
0AFE  204D                    DC    0204D        M                        1355
0AFF  4F44                    DC    04F44       OD                        1356
0B00  4520                    DC    04520       E                         1357
0B01  3D20                    DC    03D20       =                         1358
0B02  0000                    DC    0           NULL                      1359
                    .                                                     1360
                    . IF BANDWIDTH TITLE FOR DISPLAY                      1361
0B03  0008          WJDIF     DC    8           COUNT                     1362
0B04  4946                    DC    04946       IF                        1363
0B05  2042                    DC    02042        B                        1364
0B06  414E                    DC    0414E       AN                        1365
0B07  4457                    DC    04457       DW                        1366
0B08  4944                    DC    04944       ID                        1367
0B09  5448                    DC    05448       TH                        1368
0B0A  203D                    DC    0203D        =                        1369
0B0B  2020                    DC    02020                                 1370
0B0C  0000                    DC    0           NULL                      1371
                    .                                                     1372
                    . RF GAIN TITLE FOR DISPLAY                           1373
0B0D  0009          WJDRF     DC    9           COUNT                     1374
0B0E  5246                    DC    05246       RF                        1375
0B0F  2047                    DC    02047        G                        1376
0B10  4149                    DC    04149       AI                        1377
0B11  4E20                    DC    04E20       N                         1378
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LOC   OBJECT CODE      CARD IMAGE                                                         CARDNUM
0B12  3D20                     DC     03D20            =                                     1379
0B13  2020             WJDRF1  DC     02020            XX                                    1380
0B14  2020                     DC     02020            XX                                    1381
0B15  2520                     DC     02520            %                                     1382
0B16  0D0A                     DC     00D0A            CR/LF                                 1383
0B17  0000                     DC     0                NULL                                  1384
                       .                                                                     1385
                       . SIGNAL STRENGTH TITLE FOR DISPLAY                                   1386
0B18  000D             WJDSS   DC     13               COUNT                                 1387
0B19  5349                     DC     05349            SI                                    1388
0B1A  474E                     DC     0474E            GN                                    1389
0B1B  414C                     DC     0414C            AL                                    1390
0B1C  2053                     DC     02053             S                                    1391
0B1D  5452                     DC     05452            TR                                    1392
0B1E  454E                     DC     0454E            EN                                    1393
0B1F  4754                     DC     04754            GT                                    1394
0B20  4820                     DC     04820            H                                     1395
0B21  3D20                     DC     03D20            =                                     1396
0B22  2020             WJDSS1  DC     02020            XX                                    1397
0B23  2020                     DC     02020            XX                                    1398
0B24  2520                     DC     02520            %                                     1399
0B25  0D0A                     DC     0D0A             CR/LF                                 1400
0B26  0000                     DC     0                NULL                                  1401
                       .                                                                     1402
                       . TABLE OF GAIN MODES FOR DISPLAY                                     1403
0B27  0B2B             WJGMTB  DC     WJGM0            HOLD AGC                              1404
0B28  0B32                     DC     WJGM1            NOT USED                              1405
0B29  0B34                     DC     WJGM2            NORMAL AGC                            1406
0B2A  0B3C                     DC     WJGM3            MANUAL                                1407
                       .                                                                     1408
                       .                                                                     1409
0B2B  0005             WJGM0   DC     5                COUNT/HOLD AGC                        1410
0B2C  484F                     DC     0484F            HO                                    1411
0B2D  4C44                     DC     04C44            LD                                    1412
0B2E  2041                     DC     02041             A                                    1413
0B2F  4743                     DC     04743            GC                                    1414
0B30  0D0A                     DC     00D0A            CR/LF                                 1415
0B31  0000                     DC     0                NULL                                  1416
                       .                                                                     1417
                       .                                                                     1418
0B32  FFFF             WJGM1   DC     -1               COUNT/INVALID ENTRY                   1419
0B33  0000                     DC     0                NULL                                  1420
                       .                                                                     1421
                       .                                                                     1422
0B34  0006             WJGM2   DC     6                COUNT/NORMAL AGC                      1423
0B35  4E4F                     DC     04E4F            NO                                    1424
0B36  524D                     DC     0524D            RM                                    1425
0B37  414C                     DC     0414C            AL                                    1426
0B38  2041                     DC     02041             A                                    1427
0B39  4743                     DC     04743            GC                                    1428
0B3A  0D0A                     DC     00D0A            CR/LF                                 1429
0B3B  0000                     DC     0                NULL                                  1430
                       .                                                                     1431
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LOC   OBJECT CODE     CARD IMAGE                                                                      CARDNUM
                      .                                                                                 1432
0B3C  0004            WJGM3     DC    4                    COUNT/MANUAL                                 1433
0B3D  4D41                      DC    04D41                MA                                           1434
0B3E  4E55                      DC    04E55                NU                                           1435
0B3F  414C                      DC    0414C                AL                                           1436
0B40  0D0A                      DC    00D0A                CR/LF                                        1437
0B41  0000                      DC    0                    NULL                                         1438
                      .                                                                                 1439
                      . TABLE CF IF BANDWIDTHS FOR DISPLAY                                              1440
0B42  0B47            WJIFTB    DC    WJIF0                NOT USED                                     1441
0B43  0B49                      DC    WJIF1                500HZ                                        1442
0B44  0B4F                      DC    WJIF2                2KHZ                                         1443
0B45  0B55                      DC    WJIF3                4KHZ                                         1444
0B46  0B5B                      DC    WJIF4                8KHZ                                         1445
                      .                                                                                 1446
                      .                                                                                 1447
0B47  FFFF            WJIF0     DC    -1                   COUNT/INVALID ENTRY                          1448
0B48  0000                      DC    0                    NULL                                         1449
                      .                                                                                 1450
                      .                                                                                 1451
0B49  0004            WJIF1     DC    4                    COUNT/500KHZ                                 1452
0B4A  3530                      DC    03530                50                                           1453
0B4B  3020                      DC    03020                0                                            1454
0B4C  485A                      DC    0485A                HZ                                           1455
0B4D  0D0A                      DC    00D0A                CR/LF                                        1456
0B4E  0000                      DC    0                    NULL                                         1457
                      .                                                                                 1458
                      .                                                                                 1459
0B4F  0004            WJIF2     DC    4                    COUNT/2KHZ                                   1460
0B50  3220                      DC    03220                2                                            1461
0B51  4B48                      DC    04B48                KH                                           1462
0B52  5A20                      DC    05A20                Z                                            1463
0B53  0D0A                      DC    00D0A                CR/LD                                        1464
0B54  0000                      DC    0                    NULL                                         1465
                      .                                                                                 1466
                      .                                                                                 1467
0B55  0004            WJIF3     DC    4                    COUNT/4KHZ                                   1468
0B56  3420                      DC    03420                4                                            1469
0B57  4B48                      DC    04B48                KH                                           1470
0B58  5A20                      DC    05A20                Z                                            1471
0B59  0D0A                      DC    00D0A                CR/LF                                        1472
0B5A  0000                      DC    0                    NULL                                         1473
                      .                                                                                 1474
                      .                                                                                 1475
0B5B  0004            WJIF4     DC    4                    COUNT/8 KHZ                                  1476
0B5C  3820                      DC    03820                8                                            1477
0B5D  4B48                      DC    04B48                KH                                           1478
0B5E  5A20                      DC    05A20                Z                                            1479
0B5F  0D0A                      DC    00D0A                CR/LF                                        1480
0B60  0000                      DC    0                    NULL                                         1481
                      .                                                                                 1482
                      . TABLE CF DETECT MODES FOR DISPLAY                                               1483
0B61  0B69            WJDMTB    DC    WJDM1                AM                                           1484
```

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LOC   OBJECT CODE     CARD IMAGE                                                    CARDNUM
0B62  0B6D                      DC    WJDM2              FM                            1485
0B63  0B71                      DC    WJDM3              BFO FIXED                     1486
0B64  0B79                      DC    WJDM4              BFO VARIABLE                  1487
0B65  0B82                      DC    WJDM5              ISB                           1488
0B66  0B87                      DC    WJDM6              LSB                           1489
0B67  0B8C                      DC    WJDM7              USB                           1490
0B68  0B91                      DC    WJDM8              AM-NL                         1491
                                                                                       1492
                   *                                                                   1493
0B69  0002         WJDM1        DC    2                  COUNT/AM                      1494
0B6A  414D                      DC    0414D              AM                            1495
0B6B  0D0A                      DC    00D0A              CR/LF                         1496
0B6C  0000                      DC    0                  NULL                          1497
                                                                                       1498
                   *                                                                   1499
0B6D  0002         WJDM2        DC    2                  COUNT/FM                      1500
0B6E  464D                      DC    0464D              FM                            1501
0B6F  0D0A                      DC    00D0A              CR/LF                         1502
0B70  0000                      DC    0                  NULL                          1503
                                                                                       1504
                   *                                                                   1505
0B71  0006         WJDM3        DC    6                  COUNT/BFO FIXED               1506
0B72  4246                      DC    04246              BF                            1507
0B73  4F20                      DC    04F20              O                             1508
0B74  4649                      DC    04649              FI                            1509
0B75  5845                      DC    05845              XE                            1510
0B76  4420                      DC    04420              D                             1511
0B77  0D0A                      DC    00D0A              CR/LF                         1512
0B78  0000                      DC    0                  NULL                          1513
                                                                                       1514
                   *                                                                   1515
0B79  0007         WJDM4        DC    7                  COUNT/BFO VARIAELE            1516
0B7A  4246                      DC    04246              BF                            1517
0B7B  4F20                      DC    04F20              O                             1518
0B7C  5641                      DC    05641              VA                            1519
0B7D  5249                      DC    05249              RI                            1520
0B7E  4142                      DC    04142              AB                            1521
0B7F  4C45                      DC    04C45              LE                            1522
0B80  0D0A                      DC    00D0A              CR/LF                         1523
0B81  0000                      DC    0                  NULL                          1524
                                                                                       1525
                   *                                                                   1526
0B82  0003         WJDM5        DC    3                  COUNT/ISB                     1527
0B83  4953                      DC    04953              IS                            1528
0B84  4220                      DC    04220              B                             1529
0B85  0D0A                      DC    00D0A              CR/LF                         1530
0B86  0000                      DC    0                  NULL                          1531
                                                                                       1532
                   *                                                                   1533
0B87  0003         WJDM6        DC    3                  COUNT/LSB                     1534
0B88  4C53                      DC    04C53              LS                            1535
0B89  4220                      DC    04220              B                             1536
0B8A  0D0A                      DC    00D0A              CR/LF                         1537
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LOC   OBJECT CODE     CARD IMAGE                                           CARDNUM
0B8B  0000                      DC    0           NULL                       1538
                      .                                                      1539
                      .                                                      1540
0B8C  0003            WJDM7     DC    3           COUNT/USB                  1541
0B8D  5553                      DC    05553       US                         1542
0B8E  4220                      DC    04220       B                          1543
0B8F  0D0A                      DC    00D0A       CR/LF                      1544
0B90  0000                      DC    0           NULL                       1545
                      .                                                      1546
                      .                                                      1547
0B91  0004            WJDM8     DC    4           COUNT/AM-NL                1548
0B92  414D                      DC    0414D       AM                         1549
0B93  2D4E                      DC    02D4E       -N                         1550
0B94  4C20                      DC    04C20       L                          1551
0B95  0D0A                      DC    00D0A       CR/LF                      1552
0B96  0000                      DC    0           NULL                       1553
                      .                                                      1554
                      . SCAN TITLE                                           1555
0B97  0003            WJSCAN    DC    3           COUNT                      1556
0B98  5343                      DC    05343       SC                         1557
0B99  414E                      DC    0414E       AN                         1558
0B9A  0D0A                      DC    00D0A       CR/LF                      1559
0B9B  0000                      DC    0           NULL                       1560
                      .                                                      1561
                      . START FREQUENCY TITLE                                1562
0B9C  0009            WJSFS     DC    9           COUNT                      1563
0B9D  5354                      DC    05354       ST                         1564
0B9E  4152                      DC    04152       AR                         1565
0B9F  5420                      DC    05420       T                          1566
0BA0  4652                      DC    04652       FR                         1567
0BA1  4551                      DC    04551       EQ                         1568
0BA2  2049                      DC    02049        I                         1569
0BA3  4E20                      DC    04E20       N                          1570
0BA4  485A                      DC    0485A       HZ                         1571
0BA5  0D0A                      DC    00D0A       CR/LF                      1572
0BA6  0000                      DC    0           NULL                       1573
                      .                                                      1574
                      . END FREQUENCY TITLE                                  1575
0BA7  0008            WJSFE     DC    8           COUNT                      1576
0BA8  454E                      DC    0454E       EN                         1577
0BA9  4420                      DC    04420       D                          1578
0BAA  4652                      DC    04652       FR                         1579
0BAB  4551                      DC    04551       EQ                         1580
0BAC  2049                      DC    02049        I                         1581
0BAD  4E20                      DC    04E20       N                          1582
0BAE  485A                      DC    0485A       HZ                         1583
0BAF  0D0A                      DC    00D0A       CR/LF                      1584
0BB0  0000                      DC    0           NULL                       1585
                      .                                                      1586
                      . FREQUENCY INCREMENT TITLE                            1587
0BB1  000B            WJSFI     DC    11          COUNT                      1588
0BB2  4652                      DC    04652       FR                         1589
0BB3  4551                      DC    04551       EQ                         1590
```

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LOC   OBJECT CODE     CARD IMAGE                                                  CARDNUM
0BB4  2049                     DC     02049        I                                 1591
0BB5  4E43                     DC     04E43       NC                                 1592
0BB6  5245                     DC     05245       RE                                 1593
0BB7  4D45                     DC     04D45       ME                                 1594
0BB8  4E54                     DC     04E54       NT                                 1595
0BB9  2049                     DC     02049        I                                 1596
0BBA  4E20                     DC     04E20       N                                  1597
0BBB  485A                     DC     0485A       HZ                                 1598
0BBC  0D0A                     DC     00D0A       CR/LF                              1599
0BBD  0000                     DC     0           NULL                               1600
                                                                                     1601
                   . SIGNAL STRENGTH TITLE                                           1602
0BBE  000A         WJSSS       DC     10          COUNT                              1603
0BBF  5349                     DC     05349       SI                                 1604
0BC0  474E                     DC     0474E       GN                                 1605
0BC1  414C                     DC     0414C       AL                                 1606
0BC2  2053                     DC     02053        S                                 1607
0BC3  5452                     DC     05452       TR                                 1608
0BC4  454E                     DC     0454E       EN                                 1609
0BC5  4754                     DC     04754       GT                                 1610
0BC6  4820                     DC     04820       H                                  1611
0BC7  2520                     DC     02520       %                                  1612
0BC8  0D0A                     DC     00D0A       CR/LF                              1613
0BC9  0000                     DC     0           NULL                               1614
                                                                                     1615
                   . NO FIND MESSAGE FOR SCAN                                        1616
0BCA  0006         WJSNF       DC     6           COUNT                              1617
0BCB  4E4F                     DC     04E4F       NO                                 1618
0BCC  2053                     DC     02053        S                                 1619
0BCD  4947                     DC     04947       IG                                 1620
0BCE  4E41                     DC     04E41       NA                                 1621
0BCF  4C20                     DC     04C20       L                                  1622
0BD0  0D0A                     DC     00D0A       CR/LF                              1623
0BD1  0000                     DC     0           NULL                               1624
                   .                                                                 1625
                   .                                                                 1626
                   .  LOOP MESSAGE                                                   1627
0BD2  001D         WJCF        DC     29          COUNT                              1628
0BD3  0707                     DC     00707       BELL BELL                          1629
0BD4  494E                     DC     0494E       IN                                 1630
0BD5  4649                     DC     04649       FI                                 1631
0BD6  4E49                     DC     04E49       NI                                 1632
0BD7  5445                     DC     05445       TE                                 1633
0BD8  204C                     DC     0204C        L                                 1634
0BD9  4F4F                     DC     04F4F       OO                                 1635
0BDA  500D                     DC     0500D       PCR                                1636
0BDB  0A5D                     DC     00A5D       LFP                                1637
0BDC  4C45                     DC     04C45       LE                                 1638
0BDD  4153                     DC     04153       AS                                 1639
0BDE  4520                     DC     04520       E                                  1640
0BDF  4348                     DC     04348       CH                                 1641
0BE0  4543                     DC     04543       EC                                 1642
0BE1  4B20                     DC     04B20       K                                  1643
```

```
LOC   OBJECT CODE      CARD IMAGE                                                        CARDNUM

0BE2  494E                     DC      0494E              IN                                1644
0BE3  5445                     DC      05445              TE                                1645
0BE4  5246                     DC      05246              RF                                1646
0BE5  4143                     DC      04143              AC                                1647
0BE6  4520                     DC      04520              E                                 1648
0BE7  414E                     DC      0414E              AN                                1649
0BE8  4420                     DC      04420              D                                 1650
0BE9  5245                     DC      05245              RE                                1651
0BEA  4345                     DC      04345              CE                                1652
0BEB  4956                     DC      04956              IV                                1653
0BEC  4552                     DC      04552              ER                                1654
0BED  C707                     DC      00707              BELL BELL                         1655
0BEE  0D0A                     DC      00D0A              CR/LF                             1656
0BEF  0000                     DC      0000               NULL                              1657
                                                                                            1658
                               PAGE                                                         1659
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